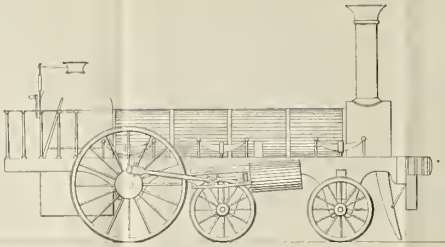
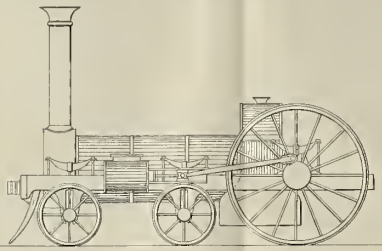
COMPARATIVE PROPORTIONS OF BROAD AND NARROW GAUGE ENGINES, SHEWING THE ANGLES OF STABILITY OF EACH.

IT WILL BE SEEN THAT N°2, CRAMPTON'S, WITH 8FT WHEELS ON THE NARROW GAUGE, HAS A SUPERIORITY OF 4° OVER THE BROAD GAUGE 7FT WHEEL ENGINE, AND 15° OVER THE NARROW GAUGE ENGINE WITH 6FT 6 WHEELS, AND WITH ALMOST A TOTAL ABSENCE OF OVERHANGING WEIGHT.

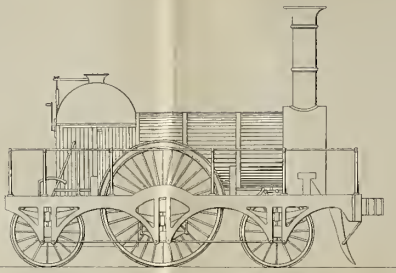
Scale ¼ of an Inch to 1 Foot



N°1 STEPHENSONS NARROW GUAGE ENGINE,
WITH 6FT 6IN DRIVING WHEELS
Used in the Gauge Experiments



N°2 CRAMPTONS NARROW GUAGE ENGINE,
WITH 8FT DRIVING WHEELS
Of the same power as N°s 1 & 3.



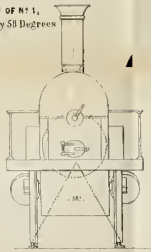
N°3 BROAD GUAGE ENGINE,
WITH 7FT DRIVING WHEELS.
Used in the Gauge Experiments

A FEW OF THE ADVANTAGES OF CRAMPTON'S ENGINE.

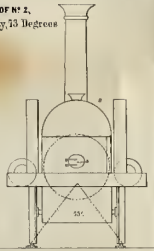
1st The rocking and vibrating action of the Engine is reduced by lowering the centre of gravity and by confining nearly the whole weight between the supports

2nd The centre of gravity not being influenced by the size of the Driving Wheel the advantages resulting from large wheels are consequently secured

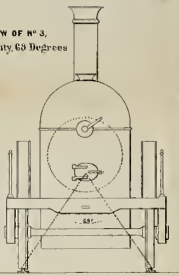
END VIEW OF N° 1,
Angle of Stability 58 Degrees



END VIEW OF N° 2,
Angle of Stability 73 Degrees



END VIEW OF N° 3,
Angle of Stability 69 Degrees



A FEW OF THE ADVANTAGES OF CRAMPTON'S ENGINE.

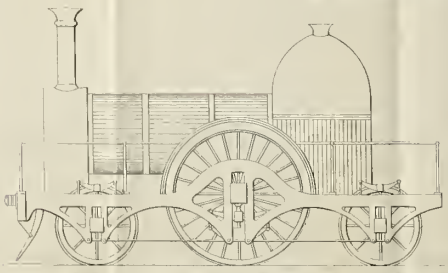
3. Four six or eight wheels may be used, the working arrangements remaining the same.

4. From the superior position of the Boiler, facilities are given for increasing the heating surface to an extent of at least 2000 feet if required and the centre of gravity not injuriously affected thereby.

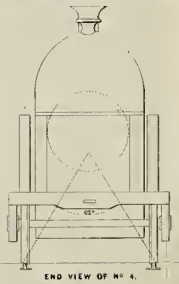
These improvements are obtained without necessarily altering the proportions and detail found to give the best effect in ordinary Engines.

MONSTER ENGINES FOR THE BROAD AND NARROW GAUGE.

THESE SKETCHES SHEW THAT CRAMPTON'S ARRANGEMENT OF ENGINE FOR THE NARROW GAUGE CAN BE MADE OF EQUAL POWER TO THE MONSTER ENGINES ON THE BROAD GAUGE, THE ANGLE OF STABILITY BEING GREATER BY 5 DEGREES

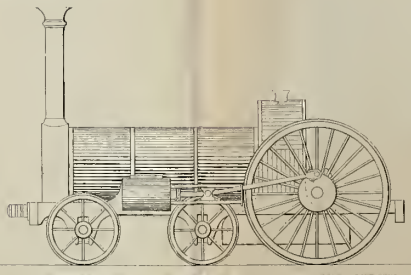


N° 4 GREAT WESTERN ENGINE WITH 8 FEET WHEELS CONTAINING 1750 FEET OF HEATING SURFACE BEING NEARLY DOUBLE THE USUAL POWER EMPLOYED



END VIEW OF N° 4.
Angle of Stability 62 Degrees

END VIEW OF N° 5.
Angle of Stability 67 Degrees



N° 5. CRAMPTON'S ENGINE FOR THE NARROW GUAGE WITH 8 FEET WHEELS CONTAINING 1750 FEET OF HEATING SURFACE.

T.R. Crampton 18 Adam St Adelphi

A FEW PLAIN REASONS

WHY THE

GAUGE COMMISSIONERS' REPORT

SHOULD

RECEIVE LEGISLATIVE SANCTION;

ILLUSTRATED WITH DRAWINGS

OF

ORDINARY & MONSTER ENGINES FOR BOTH GAUGES,

SHEWING THE

CAPABILITY OF THE NARROW GAUGE,

BOTH IN POWER AND SPEED;

AND WHY THE PUBLIC CANNOT BE CALLED ON TO PAY COMPENSATION TO THE GREAT WESTERN RAILWAY;

ALSO, A FEW REMARKS ON THE REPORT OF THE BOARD OF TRADE, AND ON THE RECENT TRIAL OF THE "GREAT WESTERN" LOCOMOTIVE.

BY ONE OF THE PUBLIC.

London:
JOHN WEALE, 59, HIGH HOLBORN.
M.DCCC.XLVI.

Price 1*s.* 6*d.*

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REMARKS

On the Report of the Board of Trade, and on the Recent Trial of the "Great Western" Locomotive.

WHILST the following pages were going through the press, the Board of Trade has reported, Parliament has discussed and adopted resolutions founded on that Report, confining the Broad Gauge to certain districts, and the "Great Western" leviathan locomotive has been tried, for the purpose of creating a sensation, according to the usual tactics of the Great Western Company, so clearly anticipated in these pages, the publication of which, might now appear, at first sight, a work of supererogation, but a little reflection will show that the question is still an open one. Government having fairly confessed their inability to deal with it abstractly, the Country must now deal with it practically; hence information, tending to elicit and form a sound public opinion on the subject, is as necessary as ever, for the Report of the Board of Trade being one of expediency, not of principle, admitting the evils, having no faith in "expedients," and wanting in firmness to support the Commissioners' remedy for the evils of a break of Gauge, cannot be considered a final settlement of that question. Further, it is stated in "Herapath's Journal," that the Report "is not the *first* drawn up, and which would have been issued from Lord Dalhousie, *per se*." If this is (as from the course of events it appears to be) correct, it is deeply to be regretted that Lord Dalhousie departed from his original decision, and pleaded his departure in the light of yielding to Broad Gauge agitation.

The Narrow Gauge Companies respectfully abstained from all appearance of interference, with the deliberations of the

Board of Trade, and paraded no array of Peers and Commoners to overawe a Government, *politically weak*, but trusted to their firmness and judgment to decide according to the evidence before them. They have not done so. Agitation, as in other cases, must now do what Government has not had the courage to perform. "*Another long adjournment—another vexatious reference to third parties,*" before the Gauge question is closed, appear the certain result of the Government's hesitation.

The public have the greatest reason to complain; for that this Report, and the Decisions of Railway Committees, give birth to a new and dangerous class of railways, which are justly dreaded by all conversant with the subject, and are only urged by the Broad Gauge party as perfectly practical. What from the heterogeneous character of the plant required to work these lines, and the number of switches and breaks in the rails for crossings and sidings, they are calculated to realize the greatest *confusion and danger* it is possible to do, on a railway. Collisions now occasionally occur on lines worked by one company, having engines of equal weight and power, with disastrous consequences; but, on this "*mongrel*" breed of railways, worked by different companies, a collision of Broad and Narrow Gauge trains would be more liable to take place, and the greater height, weight, and momentum of the Broad Gauge engine and train, "*riding rough-shod*" over the Narrow Gauge engine and train; and, picture to the mind, one or both boilers to be injured by a concussion, and steam, boiling water, and fire, in fearful combination, carrying death and destruction to one or both trains, (as the positions of the engines might be) added to the dangers incident to all collisions. Some conception may be formed of the dangerous nature of this anomalous description of railways; but it would require "*Punch*" and the "*Illustrated News*" to pourtray a journey ending with such a scene, to make the public sufficiently aware of the dangers preparing for them; all entailed, or likely to be entailed on the country, through the indecision of Government, unless a combination of intelligent and influential parties relieve the nation of this eight-limbed "Lusus Naturæ," and its parent the Broad Gauge at the same time.

On the part of the public—I protest against the introduction of the Double Gauge—I protest against their capital being subscribed for eight rails, and certain danger for one district, when four rails are denied to other districts equally important—I protest against the inconsistency of Parliament professing to limit railway capital on the one hand, and authorizing a greater expenditure on the Double Gauges, than would alter the Broad to the Narrow Gauge, and call on the "*Times*" to continue its powerful aid to free the country from such dangerous and inconsistent legislation, on purely practical matters, as a subject worthy of its great influence and reputation.

The trial of the "Great Western" leviathan locomotive, referred to in these pages, designed for a particular purpose, has taken place with all the "pomp of war," and fully corroborates the views there expressed, both as to policy and expense. As a practical exhibition of a vast concentration of power producing an equivalent performance, it is so decided a failure, that it gives no encouragement for either Broad or Narrow Gauge companies attempting to introduce with their present rails locomotives of 30 to 40 tons weight.

A tabular comparison of the performances of the "Ixion," in January, and the "Great Western," in June, will best exhibit the decided failure of the "Great Western" in realizing an equivalent performance to the "Ixion."

Table of the performances of "Ixion" and "Great Western" locomotives.

Name.	Date 1846.	Weight of Engine & Tender	Cylinder.		Heating surface.	Load.	Distance run.	Time.	Average Speed per hour.	Tractive power.
			Diam.	Stroke.						
		tons.	*inches.*	*inches.*	*sq. ft.*	*tons.*	*miles.*	*min.*	*miles.*	*lbs.*
"Ixion,"	Jany.	33	15¾	20	700	124½	53	64	49	2196
"Great Western"	June	59	18	24	1650	110½	118½	145	49	3076

The time from Paddington to Bristol, 2 hours 25 minutes, gives 49 miles an hour, and the return trip from Bristol to Paddington did not exceed 48 miles an hour. The highest speed on both trips being, from Swinden to Bath, about 70½ miles an hour, with *downward* inclines of 1 in 100! a rate of speed fre-

quently realized for short distances, and are in no wise singular or remarkable as a maximum speed. Indeed, the only surprise is, that an engine of the powers of the "Great Western" should have made so poor a performance on so fine a day. A broken pump is stated as a cause of failure; this is merely a nominal excuse; for so long as the other pump kept up the water in the boiler, no further loss of speed would arise than the short delay where the breakage occurred.

Looking at the table and observing the great disparity of the powers of the "Ixion" and "Great Western," it is a "*great fact,*" that the performance of the former is immensely superior in an economical view, and demonstrates the correctness of the ruinous policy of erecting these monster engines for passengers' trains, as discussed in this Defence of the Commissioners' Report.

It is difficult to account for so great a failure by so powerful an engine, unless the ponderous mass so deflected the rails as to "act like a break," as described by Mr. Gooch in his evidence, which would effectually check the full developement of the powers of the "Great Western," and will entail the additional expense of *new and heavier rails,* if that class of engines are to be persevered in. It is, however, probable, that the display having been made and the Commissioners' Report overthrown, such a practical failure will arrest the construction of any more of these weighty and expensive locomotives.

INTRODUCTION.

After a long and arduous investigation into the merits of the Gauges, attended with no small degree of personal risk and inconvenience, the Gauge Commissioners submitted to Parliament a valuable and judicious Report, in entire accordance with the general evidence taken by them; which Report has been made the subject of a very bitter attack by the broad Gauge party. After the able Reply which has appeared to that attack, it appeared to me at first unnecessary that any other defence of so clear a Report should be attempted, but having taken a deep interest in the whole case from the commencement, and having also in September and October in three letters to a public journal discussed the subject on general grounds, arriving at the same conclusions as the Commissioners, I had written the following pages mostly prior to the publication of the Evidence or Reply in defence of the Commissioners' Report. Although the Reply has anticipated a portion, and confirmed the general view taken, yet this being of a more practical nature, and the unbiassed opinion of one who took no part in the proceedings, and had access to no information not patent to all, it is given by "one of themselves," that the public may not be wholly unrepresented in the important question of national uniformity of Gauge, which must soon come under the decision of their representatives in the House of Commons, and which so seriously affects the public welfare.

To Mr. Crampton, I have to express my obligation for the kind manner in which he granted the use of his plate, contrasting his safety engine with those of the present construction on both Gauges, as clearly shewing the capability of the narrow Gauge using wheels of any height they choose with perfect safety, and disposing of the fallacy that the broad Gauge only could use high wheels.

From the annexed list of witnesses examined before the Commissioners, it is seen that thirty were favourable to the narrow Gauge, nine in favour of an intermediate Gauge, four only, all Officers of the Great Western Railway in favour of the broad Gauge, and three opposed to break, but expressing no opinion about width of Gauge.

ALPHABETICAL

LIST OF WITNESSES EXAMINED BEFORE THE GAUGE COMMISSIONERS.

IN FAVOUR OF UNIFORMITY AND A NARROW GAUGE.

Bass, William, Agent to Messrs. Pickford.

Bidder, G. P. Civil Engineer on Branches of the London and Birmingham, and a Friend of R. Stephenson, Esq.

Bodmer, George, Locomotive Manufacturer.

Braithwaite, John, Chief Engineer of the Eastern Counties, (adopted the narrow Gauge in lieu of 5ft Gauge.)

Buckton, Thomas, Secretary to the Brighton.

Budd, James P. Manager of Copper Works and Coal Mines, and Deputy Chairman of the Welsh Midland.

Chaplin, W. James, Chairman of the South Western, and a Carrier with Mr. Horne.

Clarke, Peter, Manager of the Brighton

Creed, Richard, Secretary to the London and Birmingham.

Ellis, John, Deputy Chairman of the Midland.

Ferneburgh, William, Superintendent of Eastern Counties Locomotives.

Harding, Wyndham, late Manager of the Bristol and Glocester.

Hawkshaw, John, Engineer of the Manchester and Leeds, selected by the Great Western in 1838 to examine the Gauges.

Head, James Brown, of Sir Robert Price's Iron and Coal Works.

Horne, Benjaman W., Carrier and Partner with Mr. Chaplin.

Hudson, George, M. P. Director of a thousand miles of Railway.

Huish, Capt. Mark, General Manager of the Grand Junction and Liverpool and Manchester.

Jones, Evans, Agent for Chaplin and Horne, Carriers at the Camden Station.

Laws, Capt. J. M., General Manager of the Leeds and Manchester.

Locke, Joseph, Civil Engineer, (who completed the Grand Junction)

M. Connell, James Edward, Superintendent of the Locomotive Department on the Bristol and Birmingham.

LIST OF WITNESSES CONTINUED.

MARTIN, Albenus, Resident Engineer and Superintendent of the South Western.

MAYNARD, Joseph, of the Firm of Messrs. PICKFORD'S, Carriers.

MILLS, Thomas C. Manager of the Good's Department of the London and Birmingham.

O'BRIEN, Capt. William, Secretary of the South Eastern.

RASTERICK, J. U. Engineer of the Brighton.

STEPHENSON, Robert, Civil Engineer, and Manufacturer of Locomotives, (Son of George Stephenson, the Inventor of Railway Locomotives)

WHITTAKER, Thomas, Civil Engineer.

WOODS, Edward, Civil Engineer.

Wood, Nicholas, Civil Engineer, (author of a celebrated work on the Steam Engine, and selected by the Great Western, in 1838, to Examine the Gauges.)

OPPOSED TO BREAK, BUT EXPRESSING NO OPINION ABOUT GAUGE.

BURGOYNE, Major-General, Sir John, Quarter-master General.

GORDON, General, Sir Willoughby, Quarter-master General.

PASLEY, Major-General, was opposed to Break, but in favour of a 5 ft. 3 in. if practicable now.

IN FAVOUR OF BROAD GAUGE, WITH A BREAK OF GAUGE.

BRUNEL, Isanbard Kingdom, (Inventor of the Broad Gauge) Engineer of the Great Western.

CLARKE, Seymour, Superintendent of Traffic on Great Western.

GOOCH, Daniel, Superintendent of Locomotives on Great Western.

SAUNDERS, Charles Alexander, Secretary of the Great Western.

INTERMEDIATE GAUGE.

BURY, Edward, Locomotive Manufacturer.

CUBETT, Benjamin, Engineer and Locomotive Manufacturer to the Croydon, Brighton and Dover.

CUBETT, William, Civil Engineer.

DOWNS, Richard, Contractor against Break.

GRAY, John, Locomotive Superintendent of the Brighton.

JACKSON, Thomas, against Break.

LARDAN, Col., late Engineer to the Greenwich, 5 feet to 6 feet.

ROBERTS, Richard, formerly a Locomotive Manufacturer.

VIGNOLES, C. Civil Engineer, in favour of a 6 feet Gauge.

Had the width of Gauge *now* to be determined on, it is probable that an intermediate Gauge might have had more supporters, but the narrow Gauge of 4 ft. $8\frac{1}{2}$ inch appears to have been taken from the width of the common cart wheels in the North of England and South of Scotland, which are 4 ft. 8 in. over the tires, the half inch being allowed for freedom and facility in working the sharp curves at Collieries and Iron Works, where railways were first successfully used by horse traction, adopting an existing standard of width which has spread itself over 2,503 miles, through all the principal mercantile districts, to the satisfaction of the commercial community against $366\frac{1}{2}$ miles of broad Gauge through less populous districts, therefore the question of width of Gauge is no longer an open one, but one between existing Gauges, whether one million, with no interruption, or twenty millions, with very serious, and, in the case of tunnels, total interruption to traffic, shall be expended to produce uniformity of Gauge, consequently the broad Gauge must shew some very decided superiority to even warrant its continuance under any limits, as obstructive to the national traffic, and as will be seen it has not shewn any such decided superiority; the Commissioners decision, that uniformity of Gauge could best be obtained by alteration of the broad to the narrow Gauge was the only and practical one they could arrive at.

DEFENCE

OF

THE GAUGE COMMISSIONERS' REPORT.

In the introduction to the "Observations on the Gauge Commissioners' Report," it is stated, "That the Question of Gauge originated as a cloak to monopoly, and that the Midland Company endeavoured to frustrate the Great Western Lines being carried up beyond Oxford or Cheltenham, towards the centre of England, and they therefore purchased an existing Line of railway between Birmingham, Gloucester, and Bristol, avowing their purpose to force down the Narrow Gauge to Bristol, and thus prevent all chance of interference by any Broad Gauge Line with the traffic in the centre of England."

Competition assumed for party purposes.

Now here, and throughout the whole of the "Observations," it is sought to establish that competition is contingent on the existence of the Broad Gauge, and that the alteration of the Broad to the Narrow Gauge would be the destruction of Railway competition.

A general review of the several Statements in the "Observations" will prove the fallacy of this position, and that the Commissioners' Report is entitled to the support of the public and of Parliament, as embodying a clear decision on the important national object of uniformity of

Competition assumed for party purposes.

Gauge; in the mean time, the inference to be drawn from the above quotation, is, that the Midland Company had unfairly purchased the Bristol and Gloucester Railway. Such is not the case. The Great Western Company had the first chance to do so, but their terms were too low, and the Midland Company made a higher offer which was accepted. In like manner the Great Western lost the working of the Line by asking too high terms, when Messrs. Stothert, Slaughter, and Co. took the working on lower terms. There is then no ground to complain that the Midland Company purchased the Bristol and Birmingham Railway, either as a cloak to monopoly, or to frustrate Broad Gauge Lines being carried to the centre of England, when it was a fair commercial transaction between a seller and two buyers, in which the Broad Gauge purchaser demanded a high rate for working, and was beaten by a private firm, and offered a low rate of interest on the capital, and was beaten by a Narrow Gauge purchaser; and is not the Great Western Company now pursuing the same policy towards the Bristol and Exeter Company? and should the Midland Company again agree to lease that Line at a higher rate than offered by the Great Western Company, what right would the latter have to complain of interference, when they declined to avail themselves of their position to conclude a fair and equitable arrangement with the Bristol and Exeter Company? The lease or sale of a Railway is a mercantile affair, and if A decline to purchase at a certain price, and B gives that price after A has declined to do so, what right has A to complain of B's interference; and if A has no such right morally or commercially, consequently, the Great Western Company have no title to complain of the purchase of the Bristol and Gloucester Railway; neither, after what has passed, would they have any right to complain of the purchase of the Bristol and Exeter, should it take place, and such a step would speedily end the Gauge controversy.

It is thus seen, that it was not a question of competition

to accommodate the public, but a question between rival Companies for the purchase of a Railway; and the losing party, with desperate energy, rushed into the field between Oxford and Rugby, and Oxford and Wolverhampton, to invade the Narrow Gauge territories, with the war-cry of "Competition," and was successful in both of its attacks, but so violent has been the recoil, that it will yet either make the invader a prisoner within a prescribed boundary, or annihilate it altogether; there is, there can be no alternative, and the latter is unquestionably the preferable one.

Inefficiency of Mechanical expedients.

Complaint is next made that no mechanical or other contrivance, had been resorted to, to remedy the alleged evil of a break of Gauge, when those exhibited last session at Paddington entirely failed to convince practical men of their applicability to the general traffic of the country, and all the more clearly demonstrated the inconvenience of a break of Gauge; and those who possess any doubts on this point, I would earnestly request to visit the West London Railway, where it crosses the Great Western at any time when a heavy Goods' Train of 40 or 50 loaded waggons is passing, and on the spot answer this question;—Could any mechanical contrivance, whatever, remove with safety and facility that large mass of goods from the Broad to the Narrow Gauge, equal to the ease and convenience of a turn table on Gauges of the same width?—There can only be one answer to this question, viz:— that mechanical contrivances are utterly inefficient to do so in any reasonable time, and that the traffic of the country can not be exposed to the delays and dangers of loose bodies, or loose axles, for any individual interest; consequently, the Midland Company acted wisely in not resorting to partial remedies, but in directing their attention to eradicate the source of the evil.

We are next informed that the Grand Junction Company is in favour of the Broad Gauge, and their circular letter is given as evidence thereof; but the fact is, that the Grand Junction Company had entered into an unseemly

contest with the London and Birmingham Company, and on this account formed an unnatural alliance with the Broad Gauge, and like all such contests or alliances, social, commercial, or political, ended in an intimate union of the original combatants to repel the Broad Gauge ally, yet we are requested to take the circular letter as the real opinions of the Directors of the Grand Junction Company; whilst, to every one else it is quite clear, that it was only to affect a hostile demonstration against the London and Birmingham Company, and it says little for the penetration of the Great Western Company, that they were placed in this false position.

Evidence impartially taken by Commissioners.

The evidence taken by the Commissioners is next stated to resolve itself into "Arguments, opinions, and advocacy of persons deeply interested in preventing the extension of the Broad Gauge from its very superiority; and that not being checked by Counsel is not entitled to the respect of the country." A reference to the List of Witnesses examined before the Commissioners is sufficient to show that they are the opinions of the most distinguished and talented men connected with Railways, and are at once the clearest and strongest proof that the Report of the Gauge Commissioners is in entire accordance with the great majority of the evidence taken and now before the public, and the manner in which that evidence was taken was with the distinct concurrence of Mr. Brunel and Mr. Saunders, on the part of the Great Western Company; and that such a mode of enquiry is far preferable for eliciting the truth than any legal casuistical cross-examination could have been, in reference to subjects so practical and mechanical in their nature and operations as Railways, will at once be admitted by all parties conversant with the subject.

Regulation of Speed.

In section 17 of the "Observations" complaint is made "That the Commissioners allowed Messrs. Locke and Stephenson to produce an impression on their minds that the speed of Express Trains should be restricted by law, thereby seriously prejudicing one of the most important

Regulation of Speed.

points at issue between the parties, before they had received one word of evidence to prove the security of the Broad Gauge at very high speeds."

Now this is not a fair statement, for the two accidents which took place with the Broad Gauge Express Trains caused no little sensation, and would doubtless have their influence with the Commissioners, as unquestionably they had with the public, as to the entire propriety of assigning some limit to the speed of Railways, to prevent reckless competition going on until some catastrophe compelled legislative interference: and when we have read of a challenge of £10,000 by the Narrow Gauge, and that the Broad Gauge are building an engine of 1650 feet of heating surface, 18-inch cylinder and 24-inch stroke, and 8-ft. driving wheels, calculated to exert a tractive power of 3076 lbs., at 60 miles an hour, although reported that the challenge was not accepted formally, yet this large engine is evidence that it is accepted in reality; and with such proceedings taking place by both Broad and Narrow Gauge parties, who will be bold enough to deny the expediency of regulating the speed of Railways, or the prudence of the Commissioners' suggestion at the time it was made.

It is really amusing to read of the assumed superiority of the Broad Gauge in speed, as if it were to some considerable extent; and as Mr. Gooch and Mr Bidder have each published letters on the experiments, with a full knowledge of all the minutiæ of them; in the appendix is a letter I published in the Railway Chronicle on these experiments, with information only derived from the public journals, by which it is seen that 3½ miles an hour was the actual gain in speed, arising entirely from the larger driving wheel of the Broad Gauge—surely here is no ground for the constant boasting of "superior speed" by the Broad Gauge party; and, I there distinctly stated, that if high wheels could be used on the Narrow Gauge, there would be an end to all idea of superiority in speed of the Broad Gauge. Mr. Crampton having since that time brought before the Society of Arts his design for a

Crampton's safety engine.

Crampton's safety engine.

safety engine, with wheels of 8 feet diameter, and a lower centre of gravity than the present Broad Gauge engines, which met with the Society's approbation; it also fully carries out my views, and places at the command of the Narrow Gauge, wheels as high as those used by the Broad Gauge, and having sufficient weight on the driving wheels for Passenger Trains, its safety at high velocities is quite apparent, and will enter into competition with the Broad Gauge on equal terms; and the peculiar form of fire box, substituting a large tubular for a small fire box area of heating surface, will enable Mr. Crampton to make an engine of 1650 feet heating surface, 18-inch cylinders, and 24-in. strike, with any length of connecting rod he chooses. Holding this favourable opinion, I applied for his permission to make reference to it, which he very handsomely granted, and the use of his plate, to which I beg to refer for a fair contrast of the advantages it commands, by reason of its low centre of gravity and high wheels, over any Narrow Gauge engine yet constructed, for attaining high speeds; and, to use the language of Mr. Brunel, in 1838, "There is no doubt still room for improvement; but if in so short a time we have made this great advance, it is fair to presume that we may make still further improvements:" for it must never be forgotten that whilst the Broad Gauge has constantly directed their efforts for speed, it is only recently that the Narrow Gauge have done so, and Mr. Crampton's engine is well calculated to attain the highest velocities.

Break of Gauge.

Sections 18 and 22 are devoted to show that the evils of a Break of Gauge has been assumed, not proved, and that with uniformity of Gauge, shifting of passengers and goods now take place, and would do so if there were no Broad Gauge, and, therefore, there exists no good reason for altering the Broad to the Narrow Gauge.

Now it is a well-established fact, that the Break of Gauge is an evil, seen, felt, and admitted by the whole commercial community, as well as by the travelling public, and not denied by the Broad Gauge party, but mechanical expe-

dients suggested as a sufficient remedy; therefore, to complain that the inconvenience of the Break of Gauge has been assumed, and that the partial practice on short Branch Lines is applicable to the through traffic of this country, is mere sophistry, or something worse; uniformity of Gauge the country requires, expedients they will not have; 42,850 vehicles passing through the clearing house in two months, (see table No. 9, appendix) is the most decisive proof of the advantages of uniformity of Gauge, and the Commissioners very properly recommended an alteration of the Broad Gauge to the national standard.

Section 23 is devoted to show that "The fear of competition by the Broad Gauge caused a reduction of 25 per cent. in the fares of the London and Birmingham Company, and that the effect of competition would more than counterbalance any inconvenience from a Break of Gauge." If there was no competition between Narrow Gauge Companies there might be some grounds for such a statement; but great competition now exists between Narrow Gauge Companies, and when the London and York, and other Narrow Gauge Trunk Lines come to be made, passing through other localities, both competition and accommodation to the entire country will be more increased, than it could be by introducing the Broad Gauge and confusion; consequently, the continuance of the expensive Broad Gauge can not influence a reduction of fares, or yield a sufficient counterpoise to the irremediable evils of a Break of Gauge.

Competition assumed for party purposes.

Section 24, submits "That if the Commissioners' Report be adopted it will greatly increase the number of places where a Break of Gauge would occur," by quoting an isolated paragraph, but keeping back their recommendation to reduce the Broad to the Narrow Gauge; now if the Broad is reduced to the Narrow, how can it increase the number of Breaks of Gauge? and, surely, the Broad Gauge are reduced to a low state when they thus comment on garbled extracts, which only require to be noticed to recoil with increased effect on their own heads. The

The public not liable for compensation.

The public not liable for compensation.

Commissioners' Report ought at once to be adopted in all its integrity, and the equitable means of doing so, they have left to Parliament to devise; but as it has been suggested that the public should sustain such cost of alteration, as one of that much burdened body, on their behalf, I protest against the proposition, and submit that the alteration can only be equitably and fairly carried into effect by the Great Western and other Broad Gauge Companies themselves.

The ground on which a grant of public money is claimed, is, that Parliament was a party to the formation of the Broad Gauge Railways. Now, if it is to be taken as a principle that the Legislature is liable to be called on for compensation by private Companies, who have successfully solicited them to make their projects Law, when it is discovered that such project does not work harmoniously with the general interests of the country, then, and only then, would there be any foundation for asking a grant of public money to make the Broad into a Narrow Gauge Railway; but even admitting that extreme cases require especial legislation the Broad Gauge has no such standing, for in 1838 so loud were the complaints of the Shareholders that the Directors called in Messrs. Hawkshaw and Wood to examine and report on the merits of the Gauges, who delivered able Reports condemning the Broad Gauge; but a special meeting of Shareholders, by a small majority, set aside these Reports, and resolved to persevere with the Broad Gauge; now, as neither in their proceedings or debates did they at that time once refer to Parliamentary liability, it is quite evident there was none incurred in that sense, and the question was decided on their own responsibility alone: therefore, by their own proceedings they are out of court, and have no title whatever for a grant of public money, when they declined the able and judicious recommendations of those they consulted, and which expense forms an item in their half-yearly Reports, as if a witness on the part of the public against any pecuniary compensation, for the Broad Gauge

party having followed bad advice when good was pressed on their attention by the most conclusive Reports.

The public not liable for compensation.

However, as a grant of public money to a private party involves a principle which no Government will now act on, or Legislature sanction, it is unnecessary further to discuss this part of the question, and, consequently, the Eastern Counties, the Arbroath and Forfar, the Dundee and Arbroath, and Bristol and Gloucester, only ask for powers to alter their Broad to the Narrow Gauge, *at their own expense!*

On what grounds, then, is the last remaining Broad Gauge Company entitled to compensation? or on what principle could such be entertained by Parliament?

On the contrary, has not the public a preferable claim on the Broad Gauge for obstructing the national thoroughfares, and for the expense of the Commissioners, arising solely from that obstruction? therefore, the question fairly put is not that the Broad Gauge party are entitled to compensation for altering their Gauge, but that the public are entitled to compensation from the Broad Gauge for obstruction, and expenses consequent upon the removal of that obstruction; however, should the Broad Gauge party decline to alter their Gauge after its third condemnation, first by Messrs. Hawkshaw and Wood, secondly by the Board of Trade, and lastly, by the Commissioners, there is no necessity to compel an alteration by legislative enactment; and it is well that it is so, for the very same causes which have led, and are leading to the alteration of all the other Broad Gauge Lines of Great Britain, will soon lead to the alteration of all of them, for if the Great Western obstinately persist in their Broad Gauge, Parliament is bound to see that the national intercourse suffers no interruption by any one Company whatever, and, therefore, must give every facility for a London, Exeter, and Falmouth Railway, on the west, and a London, Oxford, Cheltenham, and Gloucester Railway on the north, on the Narrow Gauge, and for this alternative the Great Western Proprietors must be prepared,

unless they see it their interest at once to acquiesce in the Report of the Gauge Commissioners.

Alteration best effected on established principles.

By table, No. 2, in the Appendix, it is seen that there was an actual depreciation in the market value of Broad Gauge Stock, within six months, of £3,375,000, most of it arising from Gauge contests, the defeat of the Report of the Board of Trade, and the Narrow Gauge in the Oxford and Wolverhampton, elevating them far above their real value, the Commissioners' decision depressing them below their worth, and as long as these Gauge contests continue, such will be the result; hence the outlay of £1,000,000 to alter the Gauge would be a profitable proceeding to the Proprietors by placing their Stock beyond the reach of such ruinous fluctuation, and when in the table, the depreciation and the amount per share required for alteration is contrasted, it becomes evident, that the Broad Gauge Proprietor in expending his ratio to effect the alteration to the Narrow Gauge, is not only doing so profitably, but is also protecting his property from competing Lines on each side, and from far greater fluctuations than those already experienced. It is further apparent from the table, that by calls on the shares not yet paid up, that money can be raised, giving the most ample time to make arrangements to meet the other liabilities of the Company as they fall due, and it is quite clear that if such alteration was fairly commenced, the rise in the market value of the Stock would far exceed the mere cost of alteration. At present, purchasers are alarmed at the apparently isolated position, if they remain a Broad Gauge Company—but by altering the Gauge you both remove that uncertainty and increase the resources of the Line, and the Stock will rapidly rise to a position second to few in the market.

Alteration would increase the value of Broad Gauge stock.

If then it has been shewn that the Broad Gauge party can readily effect the alteration themselves, and by so doing enhance the intrinsic and market value of their Stock, it is obviously impolitic and unjust to ask a grant of public money to improve private property, when such

expense of improvement would be amply repaid, and increase the value of property equal to seven times the amount of the outlay for that improvement.

Second class passengers.

Sections 25 to 27 state, that "The Narrow Gauge Express Trains do not convey second class passengers because their locomotive power is inadequate." Now, as several Narrow Gauge Lines do carry second class passengers, it cannot arise from inadequacy of locomotive power, but from other arrangements that they are not conveyed by all Narrow Gauge Express Trains; but whence all this care for second class passengers by the Broad Gauge? is it because they have failed to accomplish that superiority in speed with their Express Trains which they expected, and finding that all Narrow Gauge Lines do not carry second class passengers with the Express Trains, console themselves with this advantage, which will soon if it has not already been denied them, and when Crampton's safety engine comes to be fairly tried, there is no mechanical or practical reason, why it will not in every respect equal the performance of the most powerful engine yet built for the Broad Gauge, either in speed, in safety, or in power.

The very reverse of attention to the comforts of second class passengers has hitherto characterized the Great Western Railway, for the closed second class carriages were taken off the Line and stored up under canvas at Paddington, and open ones used in their place, until an indignant public, aided by the press, caused the alteration, of closing their second class carriages; and they are yet unlighted by night, and will not bear comparison with the Narrow Gauge second class carriages, for comfort to the passengers.

Errors of Great Western calculations.

Sections 29 and 30 are devoted to shew the inaccuracy of the Commissioners' tables, and thereby to establish another argument to overturn the Report; and as this subject is ably handed in the "Reply" to the "Observations," and as I entirely agree with the principles it is based on, and the deductions to be drawn from them, I prefer

Errors of Great Western calculations.

quoting them entire, and giving a tabular statement of the comparative economy from both the Commissioners' and the Great Western data, as proof of the soundness of the Commissioners' Argument, and that in reality the "serious arithmetical mistake" was only a "straw" at which the Broad Gauge eagerly grasped with a view to keep afloat a little longer. The Reply states, that:—

"Charge against the Commissioners of having committed a "very singular and serious arithmetical mistake," in computing the average number of passengers in each train of the London and Birmingham, and Great Western Railways.

"A charge is brought against the Commissioners of having committed "a very singular and serious arithmetical mistake," in adopting the tabular statement, p. 27; by which it appears that the average number of passengers in each train on the Great Western Railway has been only 47.2, and on the London and Birmingham 84.9. The "Observations" go on to state, that this assumed mistake of the Commissioners has arisen,—

"1*st*. From an error in the principle of their calculation, in ascertaining the average number of passengers per train, by dividing the aggregate number of miles travelled by passenger trains.

"2*nd*. From an error in the facts upon which this calculation proceeds, by dividing the total mileage of passengers travelling on the London and Birmingham Railway, *including* Branches, by the train mileage of the main line, *exclusive* of the Branches.

"With regard to the latter point, it is only necessary to observe that the Returns upon which the Commissioners' calculations are founded, were given by the London and Birmingham Company for a period *prior* to the opening of the Northampton and Peterborough Line, which is the only Branch of the London and Birmingham Railway of any importance.

"The only branches open at the time when the Returns were made, were the Leamington Branch of nine miles, and the Aylesbury Branch of six miles; and it is evident that the omission or insertion of the train mileage upon these Branches could not affect, in any material degree the result obtained from the traffic on the London and Birmingham Main Line. Even if the figures given by the Great Western Company had been correct, which is not the case, the argument deduced from the Returns would not be affected, inasmuch as these figures would still show that a gross weight of 67 tons on the Great Western Railway, was on the average only equivalent to a net load of 47 passengers, while on the London and Birmingham Railway, a gross load of 42 tons was equivalent to a net load of 68 passengers.

"Mode of ascertaining the average number of passengers per train."

"With regard to the more important objection to the principle of calculation, a very few remarks will show whether the principle adopted by the Commissioners, or that contended for by the Great Western Company, be in reality the correct one for ascertaining the average number of passengers per train, with a view to determining the amount of *useful work*, actually performed in practice upon the Wide and Narrow Gauge Lines.

"The Great Western Company seem to contend that the average number of passengers per train should be ascertained by taking the whole number of passengers, who in the whole course of the journey may have travelled by the train without regard to the distances they may have travelled. In this manner a train leaving London on a journey of one hundred miles, with ten passengers, stopping every ten miles, and taking up and setting down ten passengers at each intermediate station, would be represented as having accommodated one hundred passengers, while another train leaving London with fifty passengers, and running through, would be represented as having accommodated only half that number.

"In reality, however, the engine and carriages of the former train would not have been employed at any one point of time in doing more useful work than was represented by a load of ten passengers, while those of the latter train would have carried throughout five times as much useful load.

"The absurdity of the principle contended for by the Great Western Company will be apparent at once, when it is stated that if the average number of passengers per train were 86, as they assert (paragraph 30) for the purpose of combating the conclusion of the Commissioners, the total mileage of passengers upon their Railway for the half-year would have been 65,487,538, instead of its actual amount 35,967,713. In other words, if the "singular and serious arithmetical error" really lay on the side of the Commissioners, and not of the Great Western Company, the receipts of that Company from passengers must necessarily have been double the amount exhibited by their published balance sheet. On the other hand, the figure given by the Commissioners as representing the average number of passengers per train on the Great Western Railway reproduces precisely the same result as is shown by the published receipts.

"A very little reflection will show that the principle of calculation adopted by the Commissioners is the only one from which the true result can be obtained. Supposing a large number of passengers,

"Mode of ascertaining the average number of passengers per train.

say one hundred, to be travelling for the first ten miles, and a small number, say twenty, for the remaining ninety miles, the average useful work done by the engine will be an average between the large amount done for the short distance, and the small amount done for the long distance, which can only be ascertained by taking the sum of the separate mileages of each passenger, whether for long or short distances, and dividing it by the number of miles run by the train.

"This is precisely the principle adopted by the Commissioners, and no one would ever have thought of impugning it, had it not been for the interest of the Great Western Company to count in the large number of passengers carried for short distances, (to Slough, Reading, &c.) in order to eke out the average *useful* load carried by their trains in the whole journey, and thus to conceal the proportion which actually exists in practice, between *gross* and *net* loads upon the Great Western Railway, as compared with Narrow Gauge Railways. The Returns published by the Great Western Company, give the average number of miles travelled by each passenger, which for the last three years has been thirty-four, while upon the London and Birmingham Railway, it has been between fifty and sixty, so that it is evident by comparing the lengths of Line travelled over in each case, and the number of passengers actually booked, that the trains on the London and Birmingham Railway must, on the average, have carried nearly twice as many passengers as those on the Great Western. The point is one of great importance, inasmuch as the only possibility of impugning the result arrived at by the Commissioners of the superior economy and efficiency of the Narrow Gauge for practical purposes, is by upsetting the conclusions deduced from the figures given in the Returns of the Great Western Company themselves, respecting the weight of their trains and average number of passengers, which establish conclusively that a much larger proportion of useless or dead weight is carried on the Wide than on the Narrow Gauge. Nothing can shake this conclusion if it be true, as is stated by the Great Western Company themselves, that the average gross weight of their passenger trains (exclusive of engine and tender) is 67 tons, while the average number of passengers per train, as deduced from their own figures is 47.2—the average gross weight of Narrow Gauge trains, which carry a larger average number of passengers, being only about 40 tons.

A reference to table, No. 8, in the Appendix, shews the decided economy of the Narrow Gauge, and a short

Errors of Great Western calculations.

analysis of the Broad Gauge amended table will further corroborate that economy, and the fallacy of the Broad Gauge manner of calculation.

In the "Observations," the length of the Great Western and Branches is correctly given as 245 miles, but the London and Birmingham is not correctly given at 129 miles.

The fairest way to ascertain the cost of stock per mile, is to take the length of Line opened, multiplied by the number of years it has been opened, and dividing the total cost of stock by these miles, the correct cost per mile is obtained. On this plan, table No. 7, is constructed, which gives us 891 miles for the London and Birmingham, and 762 miles for the Great Western, and as the—

Great Western stock cost . .£622,078÷762=£816 per mile
London and Birmingham . .£474,403÷891=£535 „

In favour of Narrow Gauge 34·4 per cent.
on . . . . . £281 „

The Commissioners' Report states that "The cost of the the Broad is to the Narrow Gauge as 1· to ·763;" this analysis gives the Broad 1 to the Narrow Gauge ·655, a result less favourable to the Broad Gauge, but is a proof of the general correctness of the Commissioners' conclusions.

1.—In the amended table of the Great Western the Broad Gauge is given at 4d.·3, and the Narrow Gauge at 5d.·7 per train mile for repairs; tested by the passengers carried by each, viz.--47·2 on the Broad, and 68·2 on the Narrow Gauge, we have—

As 47·2 cost, 4d.·3 per mile : : 68·2 cost : 6d.·2 per mile; or an economy in favour of Narrow Gauge of ·5 per train mile.

2.—For locomotive power and repairs, as Broad Gauge 12d.·0 to Narrow Gauge 14·56, and—

As 47·2 : 12d.·3 : : 68·2 : 17d.·34 per mile;

or economy in favour of Narrow Gauge 2d·78 per mile.

3.—Revenue per mile, as Broad Gauge 10d.·5 to Narrow Gauge 14d.·4, and—

As 47·2 : 10d.·5 : : 68·2 : 15d.·2 per mile;

or economy to the public, by the Narrow Gauge, ·8d. per mile.

All these are based on the figures of the Broad Gauge, and the more forcibly establish the undeniable economy of the Narrow Gauge, and the sound judgment displayed by the Commissioners in reporting in its favour.

Movement of Troops.

Sections 31 to 35 attempt to shew, "That 30,000 troops, could not with present arrangements on Railways be moved in a reasonable time, especially on the Narrow Gauge, and that competition would be much more likely to increase the power to carry large masses of troops, than any uniformity of Gauge." Here, again, the delusion is brought forward, that the conversion of the Broad to the Narrow Gauge would extinguish all competition amongst Railways; but it has been seen that competition is irrespective of Gauge, consequently, a break of Gauge is an obstruction, without any counterpoise; and in the rapid movement of troops to repel a foreign foe—are the honour and interests of the country to be perilled at so critical a time to suit the views of any private Company whatever? The voice of the public says—no! the voice of the army says—no! and the voice of the legislature can only echo the public will, on so important a question, by supporting the Commissioners' Report, and thereby aid the Government in the better defence of our shores against any hostile aggressor, from the certainty of being able to concentrate their forces on any threatened point.

Expedients, designed to mislead the public.

Section 36 to 42 discuss at great length "The means of obviating the evils expected to arise from a break of Gauge." By many words and the most inadequate expedients, it is sought to lead the public from the main question, the advantages of uniformity of Gauge, but they are not to be thus deceived. The Broad Gauge was first a stumbling block to its own proprietors, over which they were prostrated in 1838. It has since become a national stumbling block, and in a clear and able Report of the Board of Trade, the great public inconvenience of a break of Gauge was first pointed out, but they were also tripped

up by the said stumbling block, and when at last the public by their representatives in the House of Commons took up the question, and obtained a Commission, who in an able Report concisely and fairly condensed the vast mass of evidence taken by them,—is that Commission also to be prostrated at the shrine of the Broad Gauge, and its Report to pass as nothing? surely not, for in the Mover of the address for the appointment of the Commission (Mr. Cobden) the country believes that Report has a cool and able supporter, whose business-like habits and energy, they fully expect to see displayed in its support, if the government do not themselves take up the question immediately, and regarding as unworthy of notice all expedients to alleviate the evils of a break of Gauge, the country looks with confidence to the Parliament supporting in all its integrity the Gauge Commissioners' Report, thereby aiding in removing another obstruction to the free and uninterrupted intercourse of communication from one end of the island to the other.

Confidence in Parliament supporting the Commissioners' Report.

Section 47 to 55 discuss the question of "Safety" at much length, and as the "Reply" gives a very able and decisive answer to the Broad Gauge accusations against the Commissioners, obtained from sources not generally available to the public, it is given entire, as a forcible exposure of the Broad Gauge "Observations."

Safety.

"SAFETY."

"As regards safety, the "Observations" complain (paragraph 47) that the Commissioners have unfairly represented the Tables of Accidents so as to prejudice the Great Western Company. With regard to the returns themselves, it is sufficient to say that they are taken from the tables published by the Railway Department of the Board of Trade in their Annual Reports, long before any inquiry respecting the Gauge was thought of, and that the only specific fact of error alleged is, that in an accident which occurred upon the Great Western Railway a passenger is represented to have been killed, whereas, in reality, he only broke his leg. Such arose from the figure 1 being accidentally placed in the wrong column. The material fact is, whether the "Observations" are right in the charge

"Charge against Commissioners of having unfairly represented the table of accidents."

"Charge against Commissioners of having unfairly represented the table of accidents."

which they make against the Commissioners of having acted unfairly towards the Great Western Company, in introducing this accident at all. This question will be best decided by quoting the following extract from the Report of the Inspector-General made upon it at the time."

"Near the eighty-sixth mile-post, the second engine suddenly went off the rails, and was followed by the two leading carriages. The second engine and carriages ran on nearly one hundred yards from the point where the former left the rails. It was a piece of great good fortune that they passed between the rails, for had they taken the opposite direction they would, in all probability, have gone over the embankment, (sixteen feet high.)

"I regret to say that one person was very seriously, and three or four others less severely, and two servants of the Company slightly hurt."

"With regard to the principle adopted by the Commissioners, viz., of considering those accidents only which occurred from the train getting off the line without any known cause, as by any possibility referable to difference of Gauge, the "Observations" impugn it, and contend (paragraph 49] that of the following classes of accidents, viz.—

1.—Collisions;

2.—Obstructions on the road;

3.—Points wrongly placed;

4.—Slips in cuttings;

5.—Subsidence in embankment;

6.—A defective state of the permanent way:

7,—Loss of Gauge;

8.—Broken or loose chairs;

9.—Fractures of wheels and axles; and,

10—From engines running off the line from some other cause,

all except the 3rd are affected materially by the condition of the Gauge."

"Total number of accidents on Wide Gauge and Narrow Gauge Railways."

"Let us assume the fact to be as contended for by the Great Western, and proceed upon it to apply their own test of the comparative safety of the two Gauges. The total number of accidents from the commencement of the publication of the Official Returns of the Board of Trade in 1840 down to 1844—the date of the last-furnished return, has been as follows:—

SUMMARY OF PASSENGERS killed in accidents to Railway Trains.—From the Reports of the Officers of the Board of Trade for 1841, 1842, and 1843.

	Number of persons killed.
On the narrow Gauge lines, ...	21
On broad Guage lines, ...	10
On lines of intermediate Gauge, ...	5

"The number of passengers conveyed over the Narrow Gauge lines, during the periods comprised in the above returns, were at least ten times the number of those conveyed over the Broad Gauge Lines. The proportion of fatal accidents then due to the Broad Gauge might be considered to have been 1-10th of those on the Narrow Gauge; we see, instead of this, that it was one-half. According to the criterion, therefore, which is contended for the Great Western Company, in opposition to the Commissioners, the Narrow Gauge is five times as safe as the Broad Gauge. It is remarkable, also, that the most fatal accident which ever occurred on a British Railway, viz.-that of the 24th Dec., 1841, by which nine persons were killed and twelve injured, occurred upon the Great Western Railway, and from one of the causes which they say ought to have been included by the Commissioners, among those materially influenced by the circumstance of Gauge, viz., Slips of a Cutting. The effects of this accident, also, were greatly aggravated by a cause connected with width of Gauge, and which the Great Western Company claim as an advantage, viz., the greater mass and momentum of the train whose motion was suddenly arrested."

"The Narrow Gauge Companies would have been contented to adopt the principle of the Commissioners, and to exclude altogether the operation of Gauge in cases where it was not immediately involved; but as the Great Western Company choose themselves to set up another test, and accuse the Commissioners of unfairness in not having adopted it, it is not beside the question to show that if tried by the test of their own choosing, the Wide Gauge, would appear decidedly inferior to the Narrow Gauge, in respect of safety."

"Recent accidents to express trains."

"With regard to the accidents which have recently occurred with express trains, it may be observed that the most serious of such accidents on the Narrow Gauge Lines occurred upon the same line—viz. the Eastern Counties Cambridge Line—which was newly completed, and where engines of a new and peculiar construction were employed; to the use of which, rather than to any question of Guage, the accidents were atttributed by the Inspector-General. The same remark applies to the accident which occured to the experimental

engine, on the Great North of England Line. It was an engine of peculiar construction, and the accident was clearly attributable to a cause independent of Gauge—viz. a defective chair. If this explanation of the accident be not allowed, why should those given by the Great Western, to palliate the two instances in which accidents occurred to their own express trains, be accepted as conclusive? In each case the *fact* is that accidents occurred to trains travelling at extraordinary speeds, and the explanation may be, either that the accident arose from excessive speed, or from some accidental defect of the rails. The Great Western Company claim the benefit of their own explanation in their own case, and refuse it in the case of their opponents; and thus, without difficulty, establish a case of superior safety. Under any circumstances the charge against the Commissioners is totally unfounded, since they *do* include the accident in question in the list of accidents on the Narrow Gauge."

"With regard to the general question of safety, it seems quite sufficient, however, in order to negative any claim to a superiority in this respect on the part of the Wide Gauge, to advert to the simple fact, that upon 500 miles of the principal Narrow Gauge Railways, upon which express trains have been constantly running for the last eight months, viz., the London and Birmingham, the Grand Junction, the Midlands, the London and South Western, and the London and Brighton—*not a single accident of any description has ever occurred* to an express train; while during the same period, two accidents have occurred to express trains upon the Great Western."

Axles.

In section 53, it is stated, "That no accident has taken place from a fractured axle on the Great Western Railway, but as they use six-wheeled carriages the liability to accident is not so great as with four-wheeled carriages, but it is understood that they have broken more crank axles and tires with their passenger trains than any other railway, arising from the greater strain on the crank at high velocities from their large wheels, and the centrifugal force of the large tire tending to fracture, beyond a smaller wheel at moderate velocities, but to contend that the width of Gauge increases the safety of the axle without increasing its weight and strength is so preposterous, that it only excites surprise that such a subject should have been introduced at all. Since this was written Mr. Connell's

letter has appeared in "Herapath's Journal," and as it confirms the real breakage of crank axles on the Broad Gauge, it is given in the appendix, with the editor's remarks thereon, and is worthy of especial attention.

Collisions.

Collisions are stated to be less likely to occur on the Broad Gauge by reason of their more powerful engines keeping better time, but the best answer to this is that Broad Gauge practice is opposed to it, and collisions have been as numerous on the Great Western as on any other railway.

Subsidence.

Subsidence on embankments is not, however, so independent of Gauge, for if we take the Broad Gauge engines to range from 20 to 36 tons, which they do, and Narrow Gauge engines from 13 to 20 tons, and take 16 tons to 22 tons as a fair average of both, the tendency to subsidence will be as the insistent weight on a new embankment, and accordingly on the Wootten-Bassett embankment when the two engines were together brought to bear on a weak part it gave way, and the second engine got off the rails whilst the first kept on, and in all probability would have taken the train safely, but for the additional weight of the second engine.

Longitudinal Bearings and Great Western rails.

As to loss of Gauge, there is so little liability to it with the longitudinal bearing, that I greatly prefer it to any other, for with a strong rail firmly fixed to the timber by two bolts at each end passing quite through, secured by a nut, and strong wood screws at short intermediate distances, with a piece of iron fitting accurately the recess in the Broad Gauge rail, entering about 3 inches into each rail at a joint, they are thus effectually secured against bad joints, for if one rail move, the other must move also, and by introducing between the rail and timber a prepared felt, the rattling sound is deadened or converted into an agreeable sensation, and however great the insistent weight of an engine may be on a railway of this description the deflection is a gradual one, and does not communicate that unpleasant alternation of rigidity and deflection which characterize most lines laid on transverse

State of the road, the primary cause of accidents.

sleepers when heavy engines at high velocities are used, and I am strongly disposed to attribute to this source the primary origin of accidents to express trains, when the engines without known cause have left the line; for very few of the lines are laid to use engines of more than 16 tons, but if engines of 20 tons are used, at higher velocities, the deflection between the sleepers will be greater, and where inequalities of the level of the rails occur, the weight of the engine by these alternate deflecting and rigid points (see table No. 10, appendix) is brought to bear irregularly and violently on the springs, lurching first towards one corner and then towards the other corner, a vertical and oscillatory motion of a dangerous kind is generated, and a tendency to leave the rails at the slightest obstruction, or even without any obstruction at all, for if the rails deflect unequally, and the rebound of the engine is caught up by the springs at the most rigid point, the greater the speed, the greater the danger of the engine jumping off the rails, and a bad chair or a bad joint, which at a moderate speed would not have been an obstruction, may at a higher velocity be the immediate, though not the only or real cause, of an accident.

A heavy engine on a line laid with transverse sleepers may be considered as a power acting on a lever of 2 to 3 feet, counterbalanced by a lesser power acting on a lever of 1 to 2 feet, to loosen the chairs and their fastenings, whilst on the Broad Gauge there is no tendency to such a result—hence it appears very clear to me that the accidents to the Narrow Gauge Express Trains are entirely irrespective of Gauge, but principally from the state of the road, and that the general adoption of the longitudinal bearings and Great Western plan of laying the rails would give the same ease and security to the Narrow, that it has done to the Broad Gauge at high velocities.

Oscillation dependent on state of road.

A reference to table No. 11, will shew that with weak rails and timbers the Great Western oscillations were slightly greater than the Grand Junction, and proves that not the width but the state of the road is the immediate

cause of oscillation. Those who have been in the habit of travelling to Slough will have had personal experience on this point. The rough, shaking motion over the old weak rails, ceasing on the new rails to a pleasant, agreeable sensation, attesting beyond dispute that it was the road which affected so much the motion of the carriage, and it was on part of this weak road that the accidents with the Great Western Express Trains took place, so similar in their nature to those of the Narrow Gauge. For safety at high velocities the six-wheeled carriage is decidedly preferable both from its greater weight and greater length of base, and their general adoption with all Express Trains would very greatly contribute to safety from the greater difficulty with which they would leave the rails, and it is particularly worthy of notice, that they were light four-wheeled vans which twice in succession left the rails on the Great Western Railway without any known cause; therefore, by the general adoption of longitudinal bearings, and of six wheeled carriages, with locomotives on Crampton's plan of high wheels and a low centre of gravity, the Narrow Gauge will command every advantage of the Broad Gauge, in reference to speed.

Advantages of Longitudinal bearings and six-wheeled carriages.

In regard to the accommodation to the country by large or small waggons for goods, we have the best of all tests, that of an enlarged experience in the emporium of England's commercial greatness, yet not a complaint has emanated from them nor any petitions to Parliament that the Broad Gauge would better suit their increasing traffic; on the contrary, as a body they have come to Parliament in a most respectful manner to request uniformity of Gauge, and unequivocally declared their preference for the Narrow Gauge, as already deeply interwoven in their commercial system, and if this is the voice of our mercantile community addressed to the Government in an able and impartial Report by the Commissioners of the Crown, by what process of reasoning, or of argument could it be shewn that the hundreds of small towns which will yet have their railways, would require larger waggons? for it

Small waggons preferable.

cannot be often repeated or enforced that the greater the number of trunk lines the greater the accommodation and competition to the entire country; and when railways, like the London and Birmingham, the Grand Junction, or the Great Western, realize a traffic greater than can be conveniently managed, this is the best index to Parliament that *more*, not *wider*, railways are required, as the public would be decided losers by increasing the capabilities of either Broad or Narrow Gauge railways, instead of new railways opening up other districts, whether agricultural, mineral, or manufacturing, at present imperfectly, or partially accommodated, relieving existing and developing dormant sources of traffic and of wealth. Hence the advantage, alike to the public and to railway companies, to have uniformity of Gauge and small waggons, leading to less delay and fewer errors than constantly occur when goods belonging to different tradesmen are packed in a large waggon.

Plans of waggons.

Plans are given in the "Observations" which prove that if any inconvenience had been experienced on the Narrow Gauge from a high centre of gravity, they would have been lowered, and its very existence is a proof that no danger attends its use, or it would have been laid aside, —(see plate No. 12.)

Sections 59 to 62, discuss at much length the question of "Speed," and protest against any limit being placed to it.

It is not the Narrow Gauge party who need wish any assigned limit to the speed of railways, but it is the public which require to be protected against head long, reckless competition—and although the Broad Gauge had a gain of 3½ miles an hour in speed in the late experiments, it is probably the last time they will do so, and may be allowed to make the most of it. These experiments might fairly be compared to a challenge given from a racing to a hunting stable, when the latter accept the challenge, and take a new untried hunter to run against a well tried racer; in the race which ensues both horses make precisely 10,320 strides in the same time, (see letter No. 3,

appendix) but the race horse reaches 19 inches more each stride than the hunter and gains the race. But when a new trial takes place, with engines of the same height of wheel, giving the same reach, and of the same generating area, it requires no great penetration to foretell that the victory will be on the side of the Narrow Gauge, from having less dead weight, and less atmospheric resistance to contend with for equal useful loads of either passengers or goods.

Economy and capability of Narrow Gauge.

Sections 63 to 95, all discuss the question of "Economy," and refer to their "amended table" as proof of the superior economy of the "Broad Gauge." It has been already shewn that the "amended table" proves the very reverse of this, and is a question admitting of easy practical solution.

An ordinary Broad Gauge engine costs about £2000, their new engines about £2,500 and large engine about £3,600, exclusive of tenders which may be taken at about £500 more. Narrow Gauge engines cost about £1500 to £2000, and may fairly be taken at £500 less per engine than the Broad Gauge. For a railway requiring 100 engines there is a first saving of £50,000 on locomotive stock alone, as is seen in this

Table of comparative Cost of Stock for a Broad and Narrow Gauge Railway.

Description of Vehicle.	Broad Gauge	Narrow Gauge	Difference	Vehicles No. of	Economy of Narrow Gauge on each class.	Total economy.
	£	£	£		£	£
Engine	2,000	1,500	500	100	50,000	
First class	713	413	300	250	75,000	
Second class.....	480	240	240	420	100,800	242,350
Tilt waggon	136	94	42	150	6,300	
Box waggon	131	90	41	250	10,250	

Now here is a clear gain of £242,350 on the same number of vehicles in favour of the Narrow Gauge, and ad-

mitting that the carriages do not hold the same number of passengers, or the waggons the same weight of goods on the Narrow as they do on the Broad Gauge, just so much the better for the public accommodation, and the interests of the companies, for as many of both carriages and waggons travel with half loads, and are detained at stations for less than quarter loads, the advantage of smaller carriages and waggons is so apparent in every point of view, that it is unnecessary further to discuss this point; and as the working expenses of both Gauges are contingent upon gradients, the amount of traffic, the price of coke and economy of management, the saving on the cost of stock, and of construction of the line is the true measure of economy, and is so simple a question, that it excites surprise to find ten pages of the "Observations" devoted to mystify so plain a subject, by abusing the Commissioners for having fairly and honourably done their duty on the important question submitted for their investigation.

Complaint is made that the Commissioners had overlooked the information given them, that more powerful engines were constructing at Swindon, and that one of them has since taken 483 tons at a higher speed, and less cost per mile than the "Hercules" Broad Guage engine did with 403 tons in the late experiments.

Not vast concentration, but economy of power that is required.

If the question was merely which could build the most powerful engine, the answer must be in favour of the Broad Gauge, but it is not, the concentration of the greatest possible weight and power on one engine, but the economical application of that power to the general traffic of the country. There was no way in which the Commissioners could notice in their Report, that more powerful engines were building at Swindon, without having first obtained information from every manufacturer of engines, whether more powerful engines were not also constructing for the Narrow Gauge Railways, or the amount of power capable of being used on them, and if this had been done it would have been found by Mr. Crampton's plan and evidence, that 2000 square feet of heating surface

could with safety be used with 8-ft. wheels on the Narrow Gauge, and therefore they could not notice the Broad Gauge information without also having noticed that of the Narrow Gauge, and fairly contrasted the merits of Crampton's safety engine with those of the Broad Gauge, and as such contrast would have been favourable to the Narrow Gauge, it might have been objected that in neither case had these more powerful engines been then tried, therefore the Commissioners acted wisely in passing over the information given them by the Broad Gauge.

Broad Gauge new engines

As the Broad Gauge new engines have long boilers, the fact of the 483 tons being taken at a less cost than the 403 tons is proof of their economy, and that the Broad Gauge are adopting what they appear desirous to condemn on the Narrow Gauge. It is also known that a large passenger engine has been turned out, but that the performances do not equal in speed those of the "Ixion," although the latter has about 300 square feet *less* heating surface than the new engine, and is the best proof of the uncertainty of the performances of new locomotives, referred to in letter No. 3. (appendix.)

A paragraph, apparently from good authority, in the "Morning Chronicle" under the head of "Mammoth Engines" states the dimensions of the "Great Western" Engine (the leviathan locomotive) as follows,—diameter of driving wheel 8 feet; cylinder 18 inches; stroke 24 inches; boiler 15 to 16 feet (including I suppose the fire box) weight of engine 36 tons, without water; weight of the tender, without either coke or water 10 tons.

The dimensions of the "Queen" engine, also built at Swindon, are,—driving wheels 7 feet diameter; stroke 24 inches; cylinder 16 inches; boiler 14 feet, (including I suppose the fire box) weight of engine, without water, 25 tons; weight of tender 9 tons, without coke or water.

From these we derive the following—

Table of weight and estimated cost of new Broad Gauge Engines.

	Cylinder.		Steam.		Weight.					Cost of Engine at £100 and Tender at £60 per ton.
	Size.	Contents.	Pressure.	At two-thirds.	Engine.	Coke.	Water.	Gross.		
	in. in.	*in.*	*lbs.*	*lbs.*	*tns.*	*tns.*	*tns.*	*tns,*	*tns.*	
Great Western..	18×24	6107	100	407133	36	1½	3½	41	59	3600
„ Tender					10	1½	6½	18		600
Queen	16+24	4824	100	321600	25	1	2½	28½	45	2500
„ Tender					9	1½	6	16½		

Weight of Broad Gauge new engines

From this table it is seen that the "Great Western" that leviathan of locomotives is double the weight and cost of an ordinary Narrow Gauge engine, and that engine and tender weigh 16½ tons more than the average passenger trains on the London and Birmingham; in other words the Great Western Company build an engine and tender of 59 tons at a cost of about £4,200 to take a load of 47 passengers, and for the same cost and weight the Narrow Gauge two engines would take 136 passengers at the Broad Gauge average of 68, or at the Commissioners more correct average of 84, the two Narrow Gauge engines would convey 164 passengers. Who then can contend that such "leviathans" are applicable to the traffic of this country and that they can be otherwise than ruinous, whether for Broad or Narrow Gauge Companies? If the "Great Western" is designed to shew what can be done on the Broad Gauge, economy in first cost, in fuel, and profitable returns must be kept out of view altogether, and a number of such engines might aptly be designated "the road to ruin" for the proprietors, as the following table shews an economy of 289 to 348 per cent. in favour of the Narrow Gauge engines both in cost and in dead weight of the engines alone, taking the latter at £1800 each engine.—

Table of comparative weight and cost per passenger of Broad and Narrow Gauge Engines.

	Weight of Engines.	Cost. £	Passengers. No. of	Passengers. Dead weight of Engine to each.	In favour of Narrow Gauge per cent.
Broad Gauge, Great Western.....	36	3600	47	15·3	
Narrow Gauge, 2 Engines	36	3600	136	5·3	289·3
" "	36	3600	164	4·3	348·9

Policy of Great Western Railway Company in 1838 & 1845, repeated in 1846.

For the Broad, or any Gauge to talk of competition against an odds of 300 per cent. is preposterous, and the Great Western are far too observant not to see this, and therefore the publication of the weight and power of the "Great Western" locomotive cannot be designed to shew the economy of the Broad Gauge, but has doubtless a more politic part to play in the drama of the "Gauges." The Great Western Company are constantly involved in these Gauge contests, and in every instance devised expedients which carried them over their difficulties. In 1838, when the Great Western Directors called in Messrs. Hawkshaw and Wood, their very able and conclusive reports were set aside by the report of a single experiment of Mr. Brunel's with the "North Star" engine, thus reported by him in his reply to the Directors.

1838	Load, tons.	Average speed.	Cost per ton, per mile.
September..	..15.9	38½	2.76
December....	40.0	40	.90

"From which it appears that in less than 3 months (the change has really been effected but lately) the performance of the engine is nearly trebled, while the consumption is reduced to a moderate quantity, or by two-thirds of the former experiments, the diminished power of the engine might be a *mechanical defect capable of being remedied*, and investigation has proved the truth of this satisfactorily. There is no doubt still room for improvement, but if in so short a time we have made this great advance,

Quotation from "Railway Times."

it is fair to presume that we may make still further improvements." On this the "Railway Times" of January 8th, 1839, remarks. "Mr. Brunel has adroitly endeavoured, by the above assertion, to give the *go-bye* to the decisive experiments related by Mr. Wood as completely negativing the advantages anticipated from the giant gauge, and giant engines of the Great Western Railway."

"But what evidence is there of the truth of this extraordinary, this almost incredible—'change' of capability? Mr. Brunel says, 'I can prove it.' Can any body else?—is the fact to be taken for granted on Mr. Brunel's authority alone? OR MUST THERE BE ANOTHER LONG ADJOURNMENT, AND ANOTHER TEDIOUS AND EXPENSIVE REFERENCE TO THIRD PARTIES."

"Well, supposing the *fact of the charge* to be as represented; what have the giant Gauge and giant engines to do with the matter? nothing whatever; let the same improvements in the generation of steam be applied to the ordinary engines, on railways of an ordinary Gauge, and *precisely the same advantages will be obtained.*"

The "Railway Times" was not only correct, but *prophetic;* there has been a seven year's "adjournment," and another "tedious and expensive reference to third parties;" and as that isolated experiment upset Messrs. Wood's and Hawkshaw's reports; as the Hydraulic expedient last year upset the Report of the Board of Trade; so is the "Great Western" Locomotive designed to upset the Commissioner's Report, by some isolated experiment, exhibiting a remarkable concentration of power in a single engine; but as in 1839, it was justly remarked by the "Railway Times," that "mechanical improvements were as applicable to Narrow as to Broad Gauge engines," so in 1846 does Crampton's engine give the Narrow Gauge the command of high wheels, large heating surface, and other advantages of the Broad Gauge, if they choose to avail themselves of it; but to build an engine and tender of 59 tons, to take a load of 47, 68, or 84 passengers, on either Broad or Narrow Gauge, is to destroy the advantages of railways

Quotation from "Railway Times."

by the enormous cost of the power, rendering impossible the maintenance of moderate fares. Therefore, as the Narrow Gauge can build engines as powerful as the Country requires—on the part of the public, and on the part of the Gauge Commissioners, I call on the Government, and on the Board of Trade, in the words of the "Railway Times" in 1839, to the Great Western proprietors,—"That if they suffer themselves to be diverted from a satisfactory and final settlement of the subject in dispute, by any manœvering on the part of the Broad Gauge Directors, or any feelings of false delicacy of their own, heavily as the country now complains of a break of Gauge, they will have further and increased cause to condemn the present apathy of Government, should it not immediately come forward in support of the Commissioners' Report, and at once put an end to all uncertainty on this important question."

Experiments.

Sections 96 to 98, discuss the experiments made before the Commissioners, but as these were not so favourable to the Broad Gauge as anticipated, very little is said about them, further than making the most of the Commissioners' admission in their favour at high velocities, that "the evaporation thus obtained on the Narrow Gauge does not produce a corresponding useful effect in the tractive power of the engine." This I had pointed out previous to the publication of the Commissioners' Report, (see No. 3. appendix) but it was not then known the real cause of this apparent dimunition of tractive power from equal quantities of steam, and could only be ascribed to some "mechanical defect, capable of being remedied," and it is still probable that part of it was so, but a large portion of it is now ascertained to arise from the different qualities of coke used. The hard and more durable coke of the Narrow Gauge evaporating a greater quantity of water per lb., but requiring a smaller blast-pipe to maintain sufficient draft on the fire, thereby increasing the back pressure on the piston, which combined with the excess of friction of the new engine, reduced the useful tractive

Experiments.

effect from the same evaporation. The softer and less durable coke of the Broad Gauge, admits of a larger blast-pipe, and less draft on the fire, but does not evaporate so much water per lb., but produces a greater useful tractive effect from the same amount of steam; hence the difference between the statements of Messrs. Gooch and Bidder admit of an easy solution, and the whole experiments, and reports of interested and disinterested parties, only the more clearly establish the undeniable conclusion—that equal amounts of power, will produce equal gross tractive effect on both Gauges, but as economy is in exact proportion to the useful load conveyed, and the Broad Gauge necessarily entails a much larger proportion of dead weight than the Narrow Gauge, the useful tractive effect of the latter will exceed that of the former by that difference, which, with the last Broad Gauge engine amounts to about 300 per cent. in favour of the Narrow Gauge ordinary engines.

Looking at the experiments as they were reported without the knowledge of the qualities of the coke, the Broad Gauge high wheels and old engines gave them a superiority in actual speed of 3½ miles per hour, but taking into consideration the different qualities of the coke, and of the friction of old and new engines, being all in favour of the Broad Gauge, it may reasonably be inferred that the Narrow Gauge engines, with the like advantages, would have proved themselves fully equal to the Broad Gauge in speed, and more than equal in power, and are proofs of the capability of the Narrow Gauge with its present class of engines, without reference to the more improved ones which will shortly be introduced.

General Pasley informs us, "That a Narrow Gauge engine with a light express train, travelled 31 miles in 30 minutes," or at the rate of 62 miles an hour, a speed barely surpassed by the Broad Gauge, and one that will not greatly be surpassed, taking into account the atmospheric resistance and the rapid movements of the machinery of a locomotive at that speed. The great increase in the

evaporating powers of the locomotive will not so much increase a speed of 62 miles an hour, as it will augment the power to take heavy loads at high velocities, and this is corroborated by what is yet known of the performances of the "Mammoth" engines of the Great Western Railway, which have not exceeded the speed of the old engines, but convey heavier loads at a higher average speed. Let this turn out as it may, the same power can be applied to the Narrow Gauge if found necessary; consequently, the effect of large engines would be the same on both Gauges, as regards conveying heavy loads at high velocities.

Deductions.

From what has been advanced, in defence of the Commissioners' Report, it is submitted, that the following general results have been clearly established.—

1.—That the question of a "Break of Gauge" originated with the proprietors of the Great Western Railway in 1838, was very fully and ably proved by the Board of Trade in 1845, and did not originate as any cloak to a "monopoly" by the Narrow Gauge Companies.

2.—That the Returns of the clearing-house proves the immense advantages of uniformity of Gauge.

3.—That a view of the heavy goods' trains of the Great Western, or London and Birmingham Railway, would amply satisfy every unprejudiced mind of the utter worthlessness of any mechanical expedients to remove such large masses of goods from one Gauge to another, and that those exhibited last year at Paddington, were unworthy of public confidence.

4.—That small carriages and waggons have been proved equal to the wants of our largest commercial cities, and are more suitable to the hundreds of small towns which will yet be reached by railways, and each require separate accommodation.

5.—That competition is irrespective of width of Gauge, and was only adopted by the Great Western to cover a commercial defeat, as a popular "war cry" in the contest of the "Gauges," and is a delusion; for with the cost of power 300 per cent. higher on their large engine, com-

Deductions.

petition would be ruinous to any Gauge; consequently, the extinction of the Broad Gauge would not affect competition injuriously, nor stop improvements, or mechanical skill, in locomotive engines, as all their improvements have originated on Narrow Gauge Railways, and is perfectly fair to those who declined to take the advice of those they consulted, but persevered, until they have become obstructions to the national thoroughfares.

6.—That the recommendations of the Commissioners are in strict accordance with the evidence taken by them, and that its adoption would ensure uniformity of Gauge.

7.—That the enquiry before the Commissioners was most impartially and ably conducted, at both personal risk and inconvenience; and that their Report cannot too soon receive legislative sanction.

8.—That the most equitable means of effecting the alteration of the Broad to the Narrow Gauge, is by following the precedent set by other Broad Gauge companies, viz.--effecting the alteration at their own expense; and that the public are in no wise liable to be called on to compensate any private company for persevering in errors which were early and ably brought under their serious consideration, and involves a principle which cannot be entertained.

9.—That there is much greater economy of stock on the Narrow Gauge, and that an analysis of the Great Western "amended table" fully establishes the accuracy of the principles of the Commissioners' Report.

10.—That the adoption of longitudinal bearings and Great Western plan of rails, with six-wheeled carriages would give the same ease and security at high velocites on the narrow, which they do on the Broad.

11.—That troops could be conveyed with greater regularity, certainty and speed with an uniform Gauge, and that a break or many breaks of Gauge at so critical a period might be disastrous to the honor, and best, and dearest interests of the country.

12.—That a large number of crank axles have broken on the Broad Gauge, and that the weight of the engine,

Deductions.

and diameter of the wheel are the proximate causes of so much breakage.

13.—That the experiments when fairly tested are favourable to the Narrow Gauge, and demonstrate its capability to enter into competition with the Broad Gauge either in power or in speed, and that the trifling advantage obtained in these experiments by the Broad Gauge engines were more the result of tact and accident than of any real superiority.

For these and various other reasons it is humbly submitted that sufficient grounds have been shewn to justify the Gauge Commissioners' Report receiving legislative sanction immediately, as uniformity of Gauge and numerous trunk lines passing through various localities, would afford greater accommodation, more competition, and better develope the resources of the entire country, than could be done by any one or two lines, however unlimited their capability:—that it is contrary to precedent, and contrary to reason, that the Report of a Commission so appointed, and supported by the accumulated mass of evidence on the Gauges, from 1838 to 1846, should be set aside by the ex-parte statements of interested partizans; and, therefore, that it is the duty of Her Majesty's Government now to embody that Report in a bill, on the principle and precedent of former Broad Gauge alterations, and give it their support in both Houses of Parliament; thereby finally closing another party contest, and extending to the home trade the same free and uninterupted intercourse, they are so wisely conceding to the foreign trade of the country, contributing alike to the interests of the nation and the individual comfort and enjoyment of all classes, from the humblest of Her Majesty's subjects, to the most exalted personage in the realm.

Estimate (by William Harding) of cost of alteration.

APPENDIX.

No. 1.

(From Wyndam Harding's Pamphlet on the Gauges.)

"*Expense of altering the Broad Gauge Railways to Narrow Gauge Railways.*"

"The method proposed is by laying a new and distinct longitudinal bearer and rails between the existing rails laid to the Broad Gauge.

"You have therefore to allow for a new single line of timber and rails, the present outside timber and rails on each line being left to you to be disposed of when the alteration is completed.

"Expense of laying a single line of rails, with longitudinal bearings, including materials, per mile:—

	£
"Timber, 150 loads, at 84s. per load	630
Rails, 70lbs. per yard, 110 tons, at £12 per ton	1,320
Laying and fitting	400
Carriage of materials, felt, screws, &c., &c.	345
	£ 2,695
"Deduct value of old materials, (iron and timber) taken at half-price	1,005
	£ 1,690
"Main Line and Branches, 242 miles, at £1690 per mile	408,980
"Alteration of switches, points, turn-tables, sidings, and platforms	30,000
"Add for contingences	100,000
"Total expense of alteration of road	£538,980

"*Expense of New Stock of Engines and Carriages adapted to the Narrow Gauge.*

"The locomotive stock on different lines has cost as follows, per mile:—

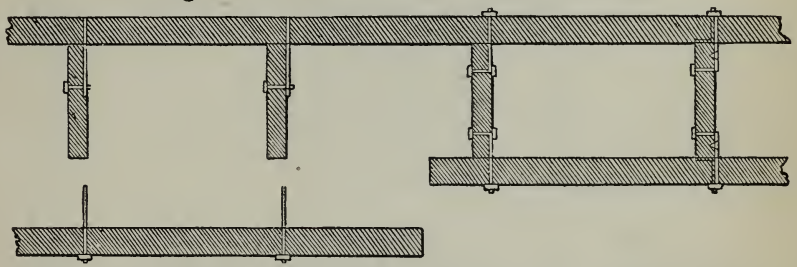
	£
"North Midland	3,357
"Grand Junction	2,441
"South Western	2,049
"Edinburgh and Glasgow	1,987

"Experience now enables us to fit up a Railway with greater economy than formerly, as we now know precisely what to order.

"I take the expense of locomotive stock of all descriptions, including engines, carriages, waggons, &c., to be—

		£
"For the Great Western	£3,000 per mile.	
"For the Bristol and Exeter line, and branches of the Great Western.....	£2,000 ditto	
"119 miles at £3,000 per mile		357,000
"129 „ 2,000 „		258,000
		£615,000
"Deduct the value of old stock, say only 15 per cent. of prime cost		90600
"Total expense of altering locomotive stock		£54,400
"Total expense of alteration of road		538,980
"Total cost of alteration		£10,63,380

Diagram, shewing the mode of altering the Broad to the Narrow Gauge, without additional rails and timbers.



Transoms cut ready to shift longitudinal frame.

Transoms cut outside longitudinal timber shifted, re-bolted to transum, and the alteration of the Broad to the Narrow Gauge complete, and no alteration of stations required.

I annex a diagram to shew that the alteration from the Broad to the Narrow Gauge can be effected in a very simple manner, without new rails, timbers, or platforms being required, at an expense which has been estimated at £60 to £80 per mile, but even at £100 per mile—

	£	
Amounts to only	242,000	for 242 miles,
And alterations of stock	538,980	
Or a total expense of alteration of	£780,980	only.

so that the Commissioners' estimate of one million for the alteration of the Broad to the Narrow Gauge would appear a full and fair estimate for all contingences, taking the more expensive mode, and considerably in excess, taking the less expensive mode of alteration, shewn in the diagram.

(No. 2.) *Tables of Fluctuation of Broad Gauge Stock, shewing plan of alteration.*

NET AND MARKET VALUE OF BROAD GAUGE STOCK.

1845.						1846.				ALTERATION. Cost.		
No. of Shares.	Amount of Share	Amount paid up.	Net value.	Market price.	Market value.	Amount paid up.	Net value.	Market price.	Market value.	Fall per Share.	Per share.	Per Share, not all paid.	Total estimated cost, one million.
£	£	£	£	£	£	£	£	£	£	£	£	£	£
25000	100	80	2,000000	218	5·450000	85	2·125000	*145	3·625000	73	14	15	375000
28000	50	50	1,400000	118	3·304000	50	1·400000	83	2·324000	35	7		
37500	20	20	750000	47	1·762500	20	750000	32	1·200000	15	3½		
39000	25					5	195000	16	624000		4½	8	312000
15000	100	70	1·050000	100	1·500000	70	1·050000	83	1·245000	17	9	15	225000
15000	33½	2	30000	11	165000	5	75000	10	150000	4	3	8	120000
120500			5,230000		12,181500	1846	5,595000		9,168000				£1,032,000
Present market value.....					9,168000								
						1845	5,230000						
Depreciation					3,013500								
Calls since 1845					365000	Calls	365000						
Net depreciation.....					£3,378500								

* Note.—Since this Table was drawn up, they have risen, and are now about 150—153 per share, but this affects not the principle, as an adverse Parliamentary decision might even send them below £154 for a time.

Table of fluctuation of Broad Gauge stock

MARKET VALUE FOR THE LAST FIVE YEARS.

Years.	Paid.	Price.	Premium	Premium per cent.	Rise.	Fall.	Value of shares per cent.
	£	£	£	£	£		
1842	65	86	21	32·3			132·3
1843	65	90	25	38·4	6·1		138·4
1844	75	125	50	66·6	28·2		166 6
1845	80	155	75	93·7	27·1		193·7
,,	80	218	138	172·5	78·8		272·5
1846	85	145	60	70·5		102·0	170·5

Letter to "Railway Chronicle" on Experiments.

(No. 3.)

"THE GAUGES."

"*To the Editor of the Railway Chronicle.*"

"SIR—When, in a former letter, I called your attention to the Reports of Messrs. Hawkshaw and Wood on the Gauges in 1838, and expressed an opinion that experiments fairly conducted in 1845 would give the same general results, I was not aware that such experiments had been determined on by the Commissioners. I am not prepared to acquiesce in the opinion, that the Narrow Gauge party were the "least wise of the three" to sanction these experiments, for so far as the published data are to be relied on, there is close approximation to the same comparative results now as there was in 1838, although the speed has increased from 27 to 47½ miles an hour. Taking the data supplied us by the Return of the express trains last summer, and the Broad Gauge average for 24 passengers as 10 tons, and the Narrow Gauge average for 18 passengers as 5½ tons, we have 8 cwt. for each Broad Gauge, and 6 cwt. for each Narrow Gauge passenger. Testing the 80 tons train by this, we have $\frac{80+20}{8}=200$ passengers for the Broad Gauge average, and $\frac{80+20}{6}=266$ passengers for the Narrow Gauge, or a proportion of 1 to 1·33 in favour of the Narrow Gauge for useful load conveyed. Taking the speed of the Broad Gauge as 47½ miles, and the Narrow at 44 miles per hour, gives a proportion of 1 to ·926 in favour of the Broad Gauge. In the table I quoted in a former number of your journal, of the experiments of 1838, the proportion of useful effect was 1 to 1·27 in favour of the Narrow Gauge, and the velocity as 1 to ·995 in favour of the Broad Gauge, from equal amounts of power employed—proportion as close as would those of two sets of experiments conducted by the same parties, on the same engines, within a week of each other. Here, then, we have nearly the same comparative results on the two Gauges after a lapse of seven years, and a general average of speed of 20 miles an hour, proving the capability of the Narrow Gauge to enter into the closest competition with the Broad Gauge, either in power or in speed, to conduct the general business of the country. That more powerful engines could be built for the Broad Gauge than for

Letter to "Railway Chronicle" on Experiments.

the Narrow, there can be no doubt; but the weight of the engines are already very destructive to the rails, and a very considerable increase in weight on either Gauge would entail the expense of stronger rails and their supports; and here I may remark, that rails laid down on the Narrow Gauge to carry engines 14 tons must be severely tried with those of 20 tons; and it is probable, that a portion of the oscillations of the Narrow Gauge engines takes its rise from the insufficiency of the permanent way, and that if laid on the continuous bearing system of the Broad Gauge, we should neither hear of "broken chairs," nor "oscillations," to the extent we now do. I annex a tabular comparison of the above experiments from the data before the public:—

1838.	Tons.	Velocity.	Ratio of velocity.	Ratio of useful effect.
Broad Gauge.....	60	26·0	1·00	1·00
Narrow Gauge	50	27·9	·995	1·27
1846.				
Broad Gauge.....	80	47·5	1·00	1·00
Narrow Gauge	80	44·0	·926	1·33

"The data for 1846 are, however, not official, and whilst the Narrow Gauge party showed little tact in taking a new engine, built on a novel plan, to experiment with, and much unfairness in passing the first mile-post as they did, at a speed of eight or ten miles an hour, the Broad Gauge party displayed superior judgment in selecting an old engine of known power, and perfect fairness in starting, yet these will not materially alter the general results, and the unfair start will be dearly purchased by the handle it affords to animadversion; whilst on the other hand, the Narrow Gauge party may complain that they were not fairly represented by the performances of a new engine of a novel design, for if they had taken a half-worn engine, with fire-box and tubes in the very best state for the rapid generation of steam, every practical man will admit that the results would have been more favourable, for no new engine works so well at first as they do eighteen or twenty-four months afterwards, when in good repair; and no engine-maker can turn out one engine only, and insure that engine to be equal to any other ten or twelve engines, made from the same drawings, either in power or speed, for in engines of the same class there is frequently greater difference in

speed than there is between the Broad and Narrow Gauges; and, as proof of this, Gen. Pasley informs us of one engine travelling "31 miles in 30 minutes," or an average speed of 62 miles an hour, and in a "stiff gale" at 43 miles an hour—a performance that well contrasts with any yet published, and it would be satisfactory to know why such an engine was excluded from the trials before the Commissioners by the Narrow Gauge party, for they found the effects of a gale equal to 13 miles an hour, and although it might have been more severe, yet 43×13=56 miles, left a good margin to work upon; and a Narrow Gauge engine that can run 62 miles an hour, need not fear comparison with any Broad Gauge engine in a trial of speed, for that will be found to be the maximum of the very best yet made. On the Broad Gauge we have the remarkable result of the same engine taking 124 tons at a greater speed than 80 tons on a previous day, without any apparent alteration of that engine. Now, this proves that it would be highly instructive, and is absolutely necessary, in a question of so much national importance, that the Commissioners should request from each party correct full-sized drawings of the "ports," "slides," and "travel" of the "slides," with the "lead," and correctly marked diagrams for each inch of the stroke of the piston, for each and every engine, and for each train experimented with, which will be embraced in their Report, in order that that Report may carry conviction to the mind of every practical man, that so important a part of the locomotive economy had not been overlooked. It is well known that much, very much of the good or bad working of a locomotive depends on the state of the "slides" being accurately adjusted for the particular work to be performed, and so nice is this adaptation, that if only one-sixteenth of an inch too much inside "lap" is given, the engine becomes "throttled" by the too long detention of the steam in the cylinder. Remove that one-sixteenth and a freer action and increased speed atttests the quicker exhaustion, whilst to the external observer there is not the slightest alteration of the engine. In like manner, alteration of the outside "lap" and "lead" produces very marked results, and, wrought by the "expansion gear," constitute the lungs and heart of the locomotive, which, when well regulated, economize the vital fluid, (if I may be allowed the expression) and give forth their pulsations with all the regularity of the animal system; and, as in the human being, diseased lungs are not early indicated by an irregular pulse, so in like manner may the lungs of a locomotive be ill-regulated, and no irregularity of pulse indicate such

State of the road, the primary cause of accidents.

Oscillation dependent on state of road.

to the external ear, yet not less surely do the disordered lungs impair the physical energy of the human being than badly-adjusted "slides" impair the speed and power of the locomotive; hence the vast importance of obtaining these drawings, or models, to determine accurately the comparative economy of the engines experimented upon, and without them all is darkness and uncertainty, as a comparative contrast of the 80 tons and 400 tons experiments will show, testing them by the respective capacities of the cylinders, only without any reference to the "slides," or their position on the "ports."

Table of Consumption of steam and comparative velocity, taken as working full stroke, and steam generated under a gross pressure of 75lb. per square inch.

Load.	Gauge.	Diameter of wheel.	Revolution in 43 miles.	Sizes of cylinder in inches.	Capacity of cylinder.	Consumption of steam.	Economy in favour of Broad Gauge.	Economy of water evaporated.	Velocity for an equal number of strokes.	Equivalent velocity per hour.
tons.		*ft. in.*	*No.*	*diam. stroke.*	*cubic inches.*	*cubic feet.*	*cubic feet.*	*cubic feet.*	*miles.*	*miles.*
80	Broad	7 0	10,320	$15\frac{3}{4} + 20$	3,896	46,540	1,212	3	43·0	47·5
..	Narrow	6 5	11,118	15 + 21	3,710	47,752			39·9	44·0
400	Broad	5 0	14,461	16 + 18	3,619	60,572	16,286	42	43·0	24·0
..	Narrow	4 6	15,658	15 × 24	4,241	76,858			38·7	21·6

"Now, by this table it is seen that with the 80 tons train there is a very close approximation in the consumption of steam between the Broad and Narrow Gauge engines, the difference in speed being precisely the difference between 10,320 the circumference of the 7-feet wheel, and 10,320 times the circumference of the $6\frac{1}{2}$-feet wheel, so that the two performances are as nearly on a par as it is possible for any two separate trials to be; but whether the consumption of steam be actually what appears in this table, or one-half less, can only be determined by knowing accurately the "lead lap" and action of the expansion gear on both engines at the time these trials were made. Taking the 400 tons experiment, we perceive a

very unexpected result on the face of the table, and one that particularly challenges investigation into the "slides" of the Narrow Gauge goods' engine. With a cylinder more capacious by 622 cubic inches, and a wheel less by 4 inches diameter, both contributing to power, the equivalent performance of the Narrow Gauge engine falls short of the Broad Gauge by $2\frac{1}{2}$ miles per hour, and expends 16,286 cubic feet of steam more than the Broad Gauge, which ought to have realized a greater speed; but it is quite possible that this very excess of steam was the main cause of retardation, by either too little "outside lap," or too little "inside lap;" and again, correct diagrams of the slides, &c., can only enable us fairly to compare the efforts made by the respective engines experimented with. If the slides of the Narrow Gauge engine were properly regulated, then it follows that a long stroke and smaller cylinder are not so well adapted for locomotives as a shorter stroke and larger cylinder, for we have here on the Broad Gauge 16-inch cylinder, taking the steam at 60 lb. above the atmosphere, an impulse of 12,060 lb. continued for 18 inches, and on the Narrow Gauge 15-inch cylinder an impulse of 10,602 lb. continued for 24 inches, with the known fact that the larger impulse and shorter stroke have accomplished the greatest performance. This is a subject worthy of further investigation, for here the Narrow Gauge are defeated where they should have excelled, whilst they are at "par" where they might freely have anticipated a defeat. The length of the 400 tons train, 290 yards was against them, as it would be about 90 yards longer than on the Broad Gauge; yet I cannot set that down as a reason why a more powerful engine failed to make an equivalent performance on the same gradients, with a passenger engine of less power than its rival of the Broad Gauge, and a correct comparison of the manner in which the steam was used in both engines at the same time, can only solve the difficulty. I have been thus particular as to these details from their importance to a locomotive engine, and the trifling difference between the Gauges, and the Commissioners, as public officers, are entitled to demand and lay before the public every information on these points, that their decision may not be given against A because B had his "slides" better regulated for that particular trial, and by that means accomplished some $2\frac{1}{2}$ miles an hour more speed. I have already far exceeded the ordinary limits of a letter; but as some of the preceding remarks bear on the subject of long boilers, so indiscreetly mixed up with the Gauge question by General Pasley, I have to crave your indulgence for a few observations on that subject.

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Steam is power; and that boiler which can generate 16,386 cubic feet more of steam in 43 miles is unquestionably the most powerful boiler; and how General Pasley came to pronounce the long boilers a failure, when it is seen that they have actually produced a greater amount of power than the Broad Gauge boiler, I am entirely at a loss to know, as I certainly never understood that they were designed to compete in power with the Broad Gauge boilers, but solely to economize fuel; aud the Broad Gauge are following the same course, for the same ends, and with equal success. The economical use of steam, when generated, I have already shown to be entirely dependent on the proper adaptation of the "slides" to the work to be done, and can have no possible reference to the Gauges whatever. Is not the fact of the Broad Gauge using *long boilers and inside frames* the best corroborative proof of the advantages of long boilers, and a practical confession that the Gauge is too broad? The dimensions given of the heating surfaces of the two boilers bear directly on the question of fire-boxes, the proportions being widely different, as is seen in the annexed table of dimensions of the boiler of the goods' engine, with which the 400 tons experiments were made:—

	Area of Fire box.	Area of Tubes.	Ratio of Fire box to Tubes.	Ratio of Fire box to Tubes.
	sq. ft.	*sq. ft.*		
Broad Gauge.....	97	600	1·0	6·18
Narrow Gauge	60	900	1.0	15· 0

Now, although I do not see clearly how 900 square feet of tubular area could be in a boiler of less diameter than 4 feet, and 13 feet long, or $1\frac{1}{2}$ times the length of the Broad Gauge, yet I have no data to correct this, if wrong, and therefore take it as given by the reporters, and it shows that the smaller fire-box and larger tubular area generate more steam than the larger fire-box and smaller tubular area, and are proof of the sound principles adopted in the construction of long boilers, which well economize fuel, notwithstanding the effect of the atmosphere on so small a fire each time the door is opened to supply fuel. The portion of the boiler on the wheels, and the proper adjustment of the weight on the springs, bear the same relation to the steadiness of the engine that the "slides" do to the economy of the steam, and your practical readers must excuse my giving an opinion, that with express engines the greatest weight should be on the leading wheels, which might cause some slipping

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at starting, but which the easy action and steady motion of the engine would amply compensate long before the end of the trip; and I would attribute the "rolling motion," referred to by General Pasley, to the fact that the very contrary of this had been done, and that the driving wheels were so much loaded as to make the engine a sort of balance, then would the overhanging fire-box and smoke-box act and re-act on the leading and trailing-wheels, and produce a vertical motion, and this, with badly adjusted springs or wheels, cause the rolling motion referred to, and might have a tendency to throw the engine off the rails; but the wholesale condemnation of these engines appears far too much *ex-parte* to command the respect of the public as regards the position of the wheels, and is wholly erroneous in reference to the boilers. General Pasley states that "another argument for abolishing the Narrow Gauge, and adopting 5 feet 3 inches as the standard Gauge of all our Railways, is, that it will admit of a boiler of more than 4 feet in diameter, which is the maximum dimension hitherto adopted on the Great Western Railway." This crotchet of a 6 inches wider Gauge than the narrow one appears only a new edition of Mr. Barry's letter to Mr. Hawkshaw in 1838, where it is thus stated.—"The addition of 6 inches would be ample, and I consider any thing beyond that would tend to increase the difficulties beyond what we now experience, rather than otherwise;" but the difficulties then experienced have been overcome; and the mere reiteration of this idea can carry neither weight nor conviction to the mind of the public; and more particularly so when it is seen that the Narrow Gauge boilers are the more powerful of the two, and there is now no difficulty in the Narrow Gauge using wheels of 7 or 9 feet diameter; and if the Narrow Gauge can do this, then there is an end of all idea of superiority in speed by the large wheels of the Broad Gauge, and also an end to all "rolling" or oscillating motion, by reason of the low centre of gravity of the engine; and no limit but that of weight and expense to the height of wheels or size of boiler up to $4\frac{1}{2}$ feet diameter, beyond which the Broad Gauge will scarcely dare to venture. I therefore see no reason to alter the opinion formerly expressed, that it will be the interest of the Broad Gauge party to alter their Gauge to the national standard, and thus not only remove a stumbling-block out of the way of the national traffic, but extend their resources by so doing, and, from the freedom of intercourse in all directions, realize far greater revenues than they ever can do if confined within certain limits, as has been suggested." "A Practical Man."

Official table of Experiments.

(No. 4.) *Experiments on Great Western Railway between Paddington and Didcott.*

Date.	Weight of Train.	Total coke.	Coke, less that used for getting up steam.	Distance run.	Total consumption per mile.	Total water evaporated	Water evaporated per mile.	Evaporation of water per lb. of coke.	Total time of running from Paddington to Didcott.	Maximum velocity.	Average velocity.	Remarks.
	tons.					*lbs.*			*hrs. min. sec.*	*miles pr hr.*	*miles pr hr.*	
Dec. 16	80 } 70 }	7462	7126	212	33.6	50,715	239.	7.1	1 4 13	54.	47.6	The velocity is taken as from Paddington to Didcott, only with the 80 ton train, in order to compare it with the 80 ton train from York to Darlington.
Dec. 17	60	3480	3144	106	29.6	24,640	232.4	7.8	0 57 52	60.	54.	

Experiments on Great North of England Railway between York and Darlington.

Date.	Weight of Train.	Total coke.	Coke, less that used for getting up steam.	Distance run.	Total consumption per mile.	Total water evaporated.	Water evaporated per mile.	Evaporation of water per lb. of coke.	Total time of running from York to Darlington.	Maximum velocity.	Average velocity.
	tons.					*lbs.*			*hrs. min. sec*	*miles pr hr.*	*miles pr hr.*
Dec. 31....	80	1176	—	44¼	26.5	10,430	235.7	8.8	0 56 52	51.	44.3
Dec. 31....	50	2464	2128	88½	24.0	20,520	232.	9.6	0 51 56	57.	48-0

Velocity maintained over first 10 miles with Train of 80 tons } Broad Gauge, 43.9 miles per hour. Narrow Gauge, 44.8 ,,

"By an examination of this table it appears,—

"1st, That the advantage of speed due to the Broad Gauge over the whole distance, both as regards the *maximum* attained and the average maintained, with the 80 ton train, is 3 miles per hour. The value of this will be fairly represented and the amount of practical advantage rendered most clear by the statement of the fact, that to a traveller there would be a saving of three minutes sixteen seconds on a journey of fifty miles, if no intermediate stoppage were made.

"2nd, That the advantage of speed over the first ten miles due to the Narrow Gauge is one mile per hour, by which 16·5 seconds will be saved every ten miles, or one minute twenty-two seconds on the same distance of fifty miles, if a stoppage be made every ten miles. This latter being much the more general case in practice.

"3rd, That the evaporating power of the locomotive engines on both Gauges, is almost identical. And

"4th, That the economy of fuel is very decidedly in favour of the Narrow Gauge. The consumption on the Broad Gauge being 36·6 lbs. of coke per mile, and on the Narrow, only 26·5 lbs. per mile.

"It is asserted in the Reply of the advocates of the Broad Gauge, without any foundation on truth, that the Narrow Gauge engine was constructed specially for the purpose of these experiments.

"The engine used on the Narrow Gauge experiments, was not specially constructed for the purpose."

"This class of engine was ordered nearly two years ago by the Great North of England Railway Company, and was then designed for the purpose of running quicker trains than had hitherto been adopted, and although this description of engine has fulfilled the objects for which it was designed, it is found that a due regard to the public accommodation in the practical working of a railway, where stoppages at intermediate stations are absolutely necessary, renders it impossible to maintain the high speeds which were once contemplated.

"That this is fully borne out in practice on both Gauges is indisputably proved by comparing the published time tables of the different companies."

Official table of Comparative Economy, and Great Western amended ditto.

(No. 5.)

TABLE (as published in the Report of Gauge Commissioners) exhibiting the expenditure of the Great Western and London and Birmingham Railways, for locomotive engines, carriages, and waggons, from the commencement of the traffic to the present time; also the revenue returns of each for the last two years, and the expense of locomotive power, as deduced from the half-yearly reports of each Company.

	£	s.	d.	
Great Western.—Total cost of locomotive engines, tenders, carriages & waggons' to 30th June, 1845.....	622,078	12	0	.... Proportion of £622,078 12s. total cost of stock for 222 miles Great Western (including, as above-mentioned, the Bristol and Exeter and the Cheltenham and Oxford Railways) would be £2,802, or for 245 miles ..... £2,539 2s. per mile of railway.
London and Birmingham.—Total cost of locomotive engines, tenders, carriages, and waggons, to 30th June, 1845....	474,403	5	3	.... Proportion of £474,403 5s. 3d. total cost for 113 miles, London and Birmingham Railway, would be £4,198, or for 129 miles ..... £3,677 10s. per mile of Railway.

TABLE *as amended,* exhibiting the *Comparative Expenditure* of the Great Western (which includes the Bristol and Exeter, the Cheltenham and Oxford lines) and the London and Birmingham Railways, for locomotive engines, carriages, and waggons, from the commencement of the traffic to the present time; also the revenue returns of each for the last two years, and the expense of locomotive power, as deduced from the half-yearly reports of each Company.

These sums are exclusive of the charges for locomotive, carriages and waggon repairs, included in the half-yearly accounts. These latter have amounted in the last two years to—				
Great Western—Form 1st July, 1843, to 30th June, 1845	56,932	17	9	Proportion of £56,932 17s. 9d. stock repairs per mile run by the Great Western, viz. for 3,101,763 train miles ..... 4·3d. per train mile.
London and Birmingham—From 1st July, 1843, to 30th June, 1845	57,578	8	5	Proportion of £57,578 8s. 5d. ditto per mile run by the London and Birmingham, viz. for 2,408,917 train miles ..... 5·7d. per train mile.
The cost of locomotive power, including repairs of locomotive engines, coal, coke, wages, and all incidental charges, have amounted in the same period to—				
Great Western—From 1st July, 1843, to 30th June, 1845	155,902	2	0	Proportion of £155,902 2s. cost of locomotive power, per mile run by the Great Western trains, as above ..... 1s. 0d. per train mile.
London and Birmingham—From 1st July, 1843, to 30th June, 1845	146,172	3	3	Proportion of £146,172 3s. 3d. ditto per mile run by the London and Birmingham trains, as above..... 1s. 2·56d. per train mile.
The revenue for the same two years, for the carriage of passengers, mails, goods, &c.—				
Great Western—From 1st July, 1843, to 30th June, 1845	1,617,995	8	2	Proportion of revenue or charge made to the public per mile train, travelled on the Great Western, as above ..... 10s. 5d. per train mile.

Official table of Comparative Economy, and Great Western amended ditto.

Official table of Comparative Economy, and Great Western amended ditto.

(No. 5, continued.)

London and Birmingham—From 1st July, 1843, to 30th June, 1845 ..... 1,735,795 14 3.... Proportion of revenue or charge made to the public per mile train travelled on the London and Birmingham, as above 14s. 4d. per train mile.

The total mileage of every passenger for the last two years amounts to—

Great Western—Total mileage from 1st July, 1843, to 30th June, 1845 128,524,232

London and Birmingham—Total mileage from 1st July, 1843, to 30th June, 1245 121,529,606

	Great Western.		London and Birmingham.		Great Western.		London and Birmingham.
Ratio of cost of engine and carriage plant	1	to	·763....	Ratio of cost of engine and carriage plant per mile of railway.....	1	to	1·448
Ditto of repairs of ditto for two years..	1	to	1·011....	Ratio of cost of repairs of ditto for two years per train mile	1	to	1·325
Ditto of cost of locomotive power for do.	1	to	·049....	Ratio of cost of locomotive power for two years, per train mile	1	to	1·213
Ditto of passengers' mileage for ditto..	1	to	·945				
Ditto of total passengers' revenue for do.	1	to	1·072....	Ratio of general revenue for two years, per train mile.....	1	to	1.375

(No. 5, continued.)

Official table of Comparative Economy, and Great Western amended ditto.

During the periods which these returns embrace, the lengths of line worked by the Great Western have varied by the opening of different lines and branches; but from the 30th December, 1844, to June 30th, 1845, the number of miles worked have been constant, viz. 222 miles. The length worked by the London and Birmingham has also been constant during the same period, and Mr. Creed in his evidence states (excluding the branches) that the distance worked was 113 miles, and the revenue and mileage on this length, that is still excluding the branches, he gives as below.

Similar statements are given in the appendix of the revenue, mileage, &c., on the Great Western for a like period; from which we have the following comparisons:—

Great Western, length of line worked.....	222 miles.
London and Birmingham ditto	113 ,,
Great Western, total passengers' mileage	35,967,713 ,,
London and Birmingham ditto	38,758,260 ,,
Great Western, miles run by passenger trains	761,483 ,,
London and Birmingham ditto	456,526 ,,
Great Western, average number of passengers per train	47·2
London and Birmingham ditto	84·9*
Great Western, average passenger's revenue per train per mile	9s. 0d.
London and Birmingham ditto	14s. 9d.

TABLE *of comparative number of passengers booked at all the Stations, and of train miles with passengers and goods run during the following half-years respectively, on the Great Western and London and Birmingham Railways, including their respective branches.*

Date.	Number of Passengers.		Number of Train miles.	
	Great Western.	London and Birmingham.	Great Western.	London and Birmingham.
Half-years ending—				
31st December, 1843	904,022	419,943	681,530	560,108
30th June, 1844	826,935	371,331	692,112	559,522
31st December, 1844	963,337	480,367	807,314	608,820
30th June, 1845	1,029.751	615,904	920,807	680,467
Totals	3,724,045	1,887,545	3,101,763	2,408,917
Difference.....	1,837,500 Passengers.		692,846 Train miles.	

* The revenue and train mileage of the London and Birmingham is stated by the Commissioners in their table to exclude *that over their branches*, but the mileage of passengers *includes* their branches, and leads to an error in their average number, which should have been 68·2 instead of 84·9.

Great Western amended table of Comparative Economy analyzed.

(No. 7.) *Comparative cost of the Broad and Narrow Gauge Railways per mile per year.*

Gauge.	Length Miles.	Opened Years.	Equal. 1 year. Miles.	Branches 1 year. Miles.	Total cost of Stock. For Miles. £	In all £	Per mile. £	In favour of narrow Gauge per cent.	Mileage. Passengers.	Train.	Passengers per train. as Commissrs.	Broad Gauge
Broad	119	4	476	286	762	622,078	816		35,967,713	761,483	47·23	47·23
Narrow	113	7	791	100	891	474,403	535	34·4	38,758,260	456,526	84·898	68·2

Comparative Economy, Power, and Revenue.

From 1st July, 1843, to 30th June, 1845.

Cost Revenue, and Ratio of expense per train mile on 68·2 and 84·9 Passengers per train.

Gauge.	Train miles.	Power. £	Repairs. £	Revenue. £	Power.	Ratio. 68·2	Ratio. 84·9	Repairs.	Ratio. 68·2	Ratio. 84·9	Revenue.	Ratio. 68·2	Ratio. 84·9
Broad	3,101,763	155,902	56,932	161,7995	12·0	15·3	21·5	4·3	6·2	7·7	10 5	15·2	26·9
Narrow	2.408,917	146,172	57,578	173,5795	14·56			5·7			14 4		
Economy in favour of Narrow Gauge					·8d.	7d.·0			·5d.	2s.0d.		0s.10d.	12s.5d.

	Great Western.	London and Birmingham.
Ratio of cost of engine and carriage plant per mile of Railway, per year	1·	0·655
Ratio of cost of repairs of ditto, for two years Broad Gauge new engines, *v.* Narrow Gauge old engines and heavier loads	1	0.942
Ratio of cost of locomotive power for two years Broad Gauge new engines, *v.* Narrow Gauge old engines and heavier loads	1	0·876
Ratio of general revenue for two years.....	1	1·072
Ratio of general revenue for two years, per train mile, proving the Narrow Gauge heavier loads.....	1	1·375

(No. 8.) *Comparative weights, carriages and waggons on Broad and Narrow Guage Lines, and Broad Guage carriages, with the more practical numbers of passengers of the Narrow Guage.*

	BROAD GAUGE.							NARROW GAUGE.					
	Gross.	Tare.	Net.	Ratio net 1 to gross.	Passengers. number	Passengers. Grs. load each.	In favor of Narrow Gauge.	Gross.	Tare.	Net.	Ratio net 1 to gross.	Passengers. number	Passengers. Grs. load each.
	cwts.	*cwts.*	*cwts.*	*cwts.*	*No.*	*cwts.*		*cwts.*	*cwts.*	*cwts.*	*cwts.*	*No.*	*cwts.*
1st Class Carriage	200	152	48	4·16	32	6·25	·37	106	79	27	3·92	18	5·88
2nd Class Carriage	267	159	108	2·47	72	3·70	equal	119	71	48	2·47	32	3·70
Carriages, with Narrow Gauge No. of passengers—													
1st Class Carriage	179	152	27	6·62	18	*9·93	4·05						
2nd Class Carriage	207	159	48	4·31	32	*6·46	2·76						
Box Waggon	219	99	120	1·82			·20	146	56	90	1·62		
Tilted Waggon.....	230	110	120	1·91			·25	150	60	90	1·66		
Cattle Waggon.....	156	100	56	2·96	7	22·28	2·62	118	70	48	2·46	6	19·66
Carriage Truck.....	100	74	16	6·25	1	100·0	24·00	76	60	16	4·75	1	76·00

* The mean of these is 8·19 cwt., shewing, that in practice the Broad Gauge passengers per carriage little exceed the numbers in the Narrow Gauge carriages.

The Returns of the express trains last year gave the Broad Gauge average 24 passengers for 10 tons gross load..... 8 cwt. each passenger.
And the Narrow Gauge average 18 passengers for 5½ tons ditto ..... 6 cwt. ditto

And the 80 tons train, tested by this data, gives Broad Gauge 200 passengers, taking useful effect as ..... 1·00
And the Narrow Gauge 266 passengers, gives useful effect as ..... 1·33 or ·33 in favour of Narrow Gauge.

Weight of Carriages & Waggons.

Clearing-house Returns.

(No. 9.)

Table of the number of carriages, trucks, and horse-boxes travelling between the following towns, for the week ending 7th February, 1846.—(From Railway Chronicle.)

Stations.	Carriages.		Trucks.		Horse-boxes.		Total.
	Up.	Down.	Up.	Down.	Up.	Down.	
London and—							
Liverpool	71	74	17	14	10	7	
Manchester	36	24	2		3	2	
Birkenhead	9	12					
Fleetwood.....	7	7					
Lancaster	12	10					
Preston.....	4	3					
Gloucester	7	8	3	1	13	17	
Newcastle.....	46	48	1	1	8	1	
York	23	21	5		6	1	
Hull	4	3					
Leeds	44	30	2		2		
Sheffield	7	6					
Derby	37	23	8	6	8	1	
Nottingham	22	17					
	329	286	38	22	50	29	
Total of each	615		60		79		754

Number of Vehicles going through the Clearing-house in two months, all of them loaded.

Carriages	10,000
Carriage trucks	700
Horse boxes	1,700
Mails	450
Goods' waggons	30,000
	42,850

(No. 10.) *Deflection of Rails and Chairs, on isolated and continuous bearings, taken by Professor Barlow's improved Deflectometer.—(Wood's Report on the Gauges, 1838.)*

	Single Chair.		Midway.		Joint Chair.	
	Engine.	Carriages.	Engine.	Carriages.	Engine.	Carriages.
London and Birmingham, isolated supports, 3 feet apart	·0283	·0133	·0522	·0362	·0633	·0488
Liverpool and Manchester, ditto ditto	·0676	·0501	·0743	·0415	·0445	·0240
Grand Junction, ditto 4 feet apart	·0478	·0259	·0641	·0344		
Ditto, longitudinal timbers	·0821	·0511	·1105	·0688		
Manchester and Bolton, ditto, rails fixed by clamps	·9080	·0630	·0690	·0440	·0861	·0641
Great Western, piles cut, ditto, rails fixed by bolts	·1116	·0827	·0894	·0616	·0927	·0634
Ditto, with piles and transoms, ditto	·0991	·0697	·1669	·1477	·1274	·0981

"It is here seen, that on isolated supports there is a greater amount of deflection shewn on the rails than in the chairs, and still less deflection on the blocks and sleepers than either the chair or rails. The inference from this is, that the rails in these cases were not firmly fixed down to the chairs; and, also, that the chairs were not immoveably secured to the blocks and sleepers; and as the experiments comprehend a great many cases, it may be presumed, that such is the case generally on isolated bearings. The experiments on the Great Western Railway shew in the table a less difference of deflection between the rails and the timbers, than any of the modes of fastening, either on isolated supports, or on the continuous bearings of the Manchester and Bolton Railway: and hence we may conclude, that the mode of fastening the rails to the timbers of railways by bolts and screws, effect a firmer Junction than any of the other modes of fastening. An experiment made on the Great Western Railway, without piles, shewed an amount of deflection much less than when the piles were in action, and very little if at all inferior to stone blocks."—(*Wood on the Gauges*, 1838.)

Oscillation on Great Western and Grand Junction in 1838.

(No. 11.)

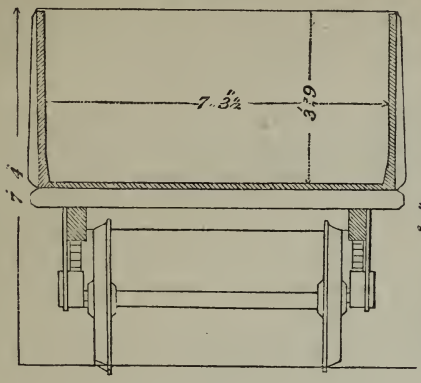
A "Table of the Smoothest Diagram on the Great Western Railway, and a Diagram of the Motion on the Grand Junction Railway."—(Wood's Report on the Gauges, 1838.)

Great Western.				Grand Junction.		
Distance. *miles.*	Velocity. *Miles per hour.*	No. of Oscillations.	Average of Oscillations. *inches.*	Velocity. *Miles per hour.*	No. of Oscillations.	Average of Oscillations. *inches.*
1	31	36	·40	16¼	47	·11
2	28	196	·39	17	181	·21
3	29	184	·58	24½	196	·33
4	30	205	·37	23¼	166	·36
5	30	191	·43	24¼	172	·42
6	29	198	·39	25	172	·43
7	29	185	·49	24½	171	·36
8	28	222	·44	25	175	·42
9	29	180	·46	24	174	·44
10	28	174	·73	24¼	170	·57
11	29½	210	·40	24	179	·51
12	28	199	·49	26½	205	·34
13	29¾	199	·50	25¾	184	·43
14	30	192	·55	13	198	·42
15	31¼	210	·48	27¼	132	·57
16	30	202	·41	29¾	115	·52
17	30	181	·46	31½	181	·51
18	16	298	·26	30	187	·48
19	23½	296	·24	30½	192	·40
20	27	243	·42	32	184	·43
21	26	202	·32	32	167	·43
22	26	43	·54	30	45	·51
		4246	9·75		3593	9·20
Mean per mile		193	·44		163	·41

(No. 12.)

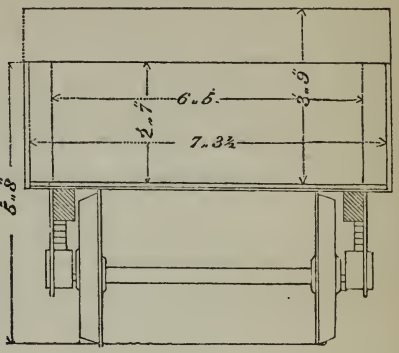
NARROW GAUGE

Small waggon.



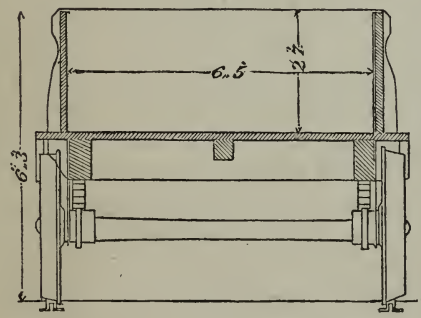
NARROW GAUGE

Small waggon on Broad Gauge plan.



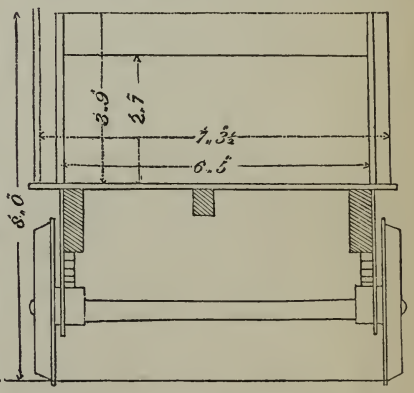
BROAD GAUGE

Small waggon.



BROAD GAUGE

Small waggon on Narrow Gauge plan.



{ The dotted lines shew the respective sizes on their own plans.

The Narrow Gauge waggon	admits lowering	6	inches clearing wheel.
,, ,,	deeper	14	inches than Broad Gauge
,, ,,	stands	20	inches higher than one of

the depth of the Broad Gauge; consequently, waggons of the same depth on wheels of the same diameter will be the same height on both Gauges, and the above plans only bear on the mode of building waggons, and not on the Gauges at all.

"Bristol and Gloucester Railway
(Locomotive Department,)
Bromsgrove, May 4, 1846."

"MR. EDITOR—On examining the minutes of evidence taken before the Commissioners appointed to enquire into the Gauge of railways, I observe it is stated by Mr. Gooch, in answer to question 2235,—

"Was not the weight of the axle increased in proportion to its length? We do not find that our axles are much greater than the Narrow Gauge in diameter; we have four inch to four and-a-quarter inch axles.

"And, again, to question 2236,

"Are we not to infer, then, that your's are too weak, or that those of the Narrow Gauge are too strong? We very seldom find ours too weak; we have, very seldom indeed, had ours to break. and it is a *common thing* on the Narrow Gange lines for these axles to break.

"Now, Sir, I beg to say so far as my experience goes in working both Gauges, the Narrow is the safest in this respect as well as others, inasmuch as on the Bristol and Gloucester Broad Gauge line, 37½ mile in length, with 10 trains in each directions daily, making a weekly mileage of 4,155, I find that we had 6 axles broken since the 6th of September last, a period of 8 months—four of these axles were crank axles of the passenger train engines, which cost on an average £100 each, and two were waggon axles—while on the Birmingham and Gloucester line, 53 miles in length, with 11 trains in each direction daily, making a weekly mileage, including short trains of 7,030 miles, I find during a period of four years and nine months we have had only five axles broken, shewing, what is manifest to me, that the tendency to strain and break the axle (a constant cause of accident on railways) is much greater on the Broad Gauge than on the Narrow. The frequency of these breakages on the Bristol and Gloucester, a short line, proves that the Broad Gauge is not suited to the sharp curves which prevail on that line, which it is worthy of remark was laid out for the Narrow Gauge, and it was only after the works were in progress that the Broad Gauge was ordered to be laid. I therefore draw the conclusion from this, that if the Broad Gauge was attempted to be laid upon the track of the Narrow Gauge railways, on all, or any of the existing lines, the same danger would arise from the torsion of axles, and the violent oscillations of the carriages round the curves, which is found to take place on the Bristol and Gloucester line, where Broad Gauge has been substituted for Narrow.

J. E. M'CONNELL."

"It will be seen by this letter, that with 4,155 miles a-week run 6 Broad Gauge axles have broken in two-thirds of a year, while, with 7,030 miles a-week run 5 Narrow Gauge axles have broken in four years and three quarters. Therefore the miles run by a Broad Gauge axle before it breaks are to the miles run by a Narrow Gauge axle as--

$$\frac{4155\times\frac{2}{3}}{6} \;.\; \frac{7030\times4\frac{3}{4}}{5} \;\ldots\; 1 \;.\; 14\tfrac{1}{2}$$

"That is, $14\frac{1}{2}$ times as many Broad Gauge axles break running over a given distance as Narrow Gauge. This is rather an extraordinary fact—a telling fact—a fact of conclusive condemnation for the Broad Gauge economy and safety to passengers.

"We presume, in deciding on the merits of the two Gauges, the Government will not overlook this most important fact. If such be the character of the Broad Gauge, that when laid down upon a line designed for the Narrow Gauge, the breakage of axles are $14\frac{1}{2}$ times more numerous than upon the Narrow, it is a clear case that the public safety would be seriously compromised by its extension and continuance. The partizans of the Broad Gauge may say, such accidents have not happened on the Great Western Railway. That is no answer at all, for besides matters being kept so closely on that line that misfortunes unattended with injury to passengers seldom creep out, the line itself, by its curves and the peculiar character of the country, is more favourably circumstanced for the Broad Gauge than probably any other line in England would be found to be. It is sufficient for us, if the statement be true—and who can doubt it, coming as it does under Mr. M'Connell's name, the Resident Superintendent of the Broad and Narrow Gauge portions of the same line?—that the actual fractures of the axles and liability to accident are FOURTEEN AND A HALF TIMES more numerous on the BROAD than on the NARROW Gauge. The striking features of the case are, that these facts come not from lines in different parts of the country, carrying different loads, and worked under different circumstances; but from the same line, carrying the same loads, one portion of which line designed for the Narrow being laid down with the Broad Gauge."—*(Herapath's Journal.)*

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